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Committee on Veterinary Medical Sciences
Commission on Life Sciences
National Research Council

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The Committee evaluated the implications of federal legislation and regulations on the need for veterinary manpower, particularly in the veterinary specialties rather than in private practice. The number of veterinarians serving in specialties other than private practice was assessed for 1981, and some earlier data was also gathered. Predictions were made for demand for veterinary specialists through 1990. Recommendations of the report include the following:

- That a comprehensive national reporting system be developed to determine accurately the number of veterinarians being used in all fields of employment;
- That educational opportunities at the DVM level be stabilized at the current number;
- That the colleges of veterinary medicine adjust their curricula and admissions criteria, to meet societal needs in environmental health protection, food production and protection, economic productivity in animal-related industries, biomedical research, and animal welfare, as well as needs for clinical care of animals, and that national guidelines postdoctoral educational programs at veterinary colleges be established;
- That postdoctoral training for veterinarians be given priority for support by federal and state government agencies;
- That use of veterinarians' biomedical expertise by government agencies be increased, and lastly,
- That economic models be developed for the application of animal-health expertise to the livestock industries, possibly through the provision of expanded community or other agribusiness services.

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NOTICE: The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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Organizations that supplied information requested by the Committee include the American Association of Colleges of Pharmacy, the American Association of Dental Schools, the American Association of Industrial Veterinarians, the American College of Veterinary Pathologists, the Association of American Medical Colleges, the Association of American Veterinary Medical Colleges, the Association of Schools of Public Health, the Association of American Colleges of Osteopathic Medicine, the American Association for Accreditation of Laboratory Animal Care, the American College of Laboratory Animal Medicine, and the National Research Council Institute of Laboratory Animal Resources and Commission on Human Resources.

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W. Jean Dodds, Chairman
Committee on Veterinary
Medical Sciences

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EXECUTIVE SUMMARY

In April 1980, the U.S. Department of Agriculture (USDA), Food and Drug Administration (FDA), National Institutes of Health (NIH), Environmental Protection Agency (EPA), and U. S. Army Medical Research and Development Command (USAMRDC) asked the National Academy of Sciences to examine the impact of federal legislation and regulations on the national requirements for veterinary medical scientists. Accordingly, the Committee on Veterinary Medical Sciences of the National Research Council (NRC) Commission on Life Sciences was charged with assessing the effect of current legislation and regulations on the need for veterinary medical scientists with competence in various research and practice specialties. This led the Committee to consider the factors associated with services provided by veterinarians today, so that it could determine the total manpower needs. The Committee performed the following tasks:

- Defined functional responsibilities currently met by veterinarians.
- Identified organizational settings and biomedical disciplines in which veterinarians currently perform activities related to the defined functional responsibilities.
- Identified the number of veterinarians working in the organizational settings.
- Analyzed appropriate federal legislation and identified activities mandated or caused by that legislation related to the functional responsibilities and specialty disciplines of veterinarians.
- Estimated the future needs for veterinary specialists in major organizational settings.
- Projected the number of new veterinarians that will be produced during the next decade and the total population of veterinarians available for service during the same period.

Analysis of functional responsibilities of veterinarians revealed that their activities are usually multifaceted and have impacts of benefit to both animal and human health. The Committee defined 10 functional responsibilities: administration, animal health care, animal welfare, biomedical research, economic productivity of animal-related industries, environmental health protection, food production and protection, health education, mental and emotional health (as related to companion-animal care), and prevention of zoonoses.

The skills and expertise of veterinary medicine were found to be delivered to users through a variety of organizational settings, including private practice, institutional practice, preventive medicine, teaching and research, and industrial and international veterinary medicine.

Major findings of this report are threefold: the current numbers of veterinarians contributing to non-private-practice endeavors have been documented; the deficiencies in the existing data base concerning the activities of such veterinarians have been identified; and the total number of veterinary specialists has been determined to be small, with just over 2,000 board-certified specialists among the 8,760 non-private-practice veterinarians in 1981.

Despite the fact that the percentage of veterinarians not in private practice has decreased over the last decade, the Committee recognizes that veterinarians, by virtue of their expertise and skills, will continue to fulfill important societal needs in teaching, research, and administration. The Committee believes that the use of veterinarians by the non-private-practice sector has been limited by two factors: the economic incentives of private practice have outweighed those of alternative endeavors, thus holding down the supply of veterinarians for nonprivate practice; and some health professionals including veterinarians in decision-making positions, fail to adequately recognize that veterinarians can bring valuable skills and expertise to biomedical problem-solving and administration not associated with primary patient care.

The Committee believes that the use of veterinarians' biomedical expertise by government agencies should be expanded. We also believe that the use of veterinarians for tasks that can be performed by other trained persons should be decreased. Agency heads should be made aware of the skills, knowledge, and unique qualifications of veterinarians that could be applied to meet program goals and responsibilities and that federal salaries for veterinarians should be more competitive with those of Ph.D. and M.D. biomedical scientists, particularly if specialty training in addition to the veterinary degree has been obtained.

The analysis of federal legislation revealed many activities with an impact on the functional responsibilities of veterinarians. Some of these, such as laboratory-animal medicine and comparative pathology, are usually identified with the veterinary profession; others, such as toxicology, are not the exclusive domain of veterinarians, but veterinarians with specialty training could make contributions. The federal legislation influencing veterinary medical manpower is described in Appendix B.

The Committee has attempted to estimate the future needs for services in the various organizational settings by analyzing each of the major veterinary-manpower studies completed since the 1961 Humphrey Report, by seeking the opinions of consultants and administrators in federal agencies and industry and by drawing on the knowledge of its own members. It is the opinion of the Committee that the need for veterinarians to deliver private-practice patient care in this decade will be met by the projected supply.

The lack of a suitable existing data base makes it difficult, on the basis of historical employment trends, to predict future needs in the non-private-practice sector. Employment of veterinarians by the major U.S. regulatory agencies remained roughly constant during the last decade. Whether this was based on technical needs or on the availability of funds and appropriately trained persons was not determined. The employment of veterinarians by industry increased during the last decade, primarily in pathology and laboratory-animal medicine. Data gathered by the Committee indicate that there will be a demand for additional veterinarians in those disciplines in industrial and contract research laboratories. The Committee believes that such organizations as the Association of American Veterinary Medical Colleges (AAVMC) and the American Veterinary Medical Association (AVMA) should expand their data-gathering efforts to collect more information on the veterinary manpower used by the non-private-practice sector. A comprehensive survey of this sector should be conducted in the near future to assist in the development of predictions of employment in areas other than private practice. The Committee predicts that there will be an increased overall need for veterinarians in the non-private-practice sector.

The number of veterinary graduates produced each year for the rest of this decade is expected to increase modestly. The increase will be due primarily to the establishment of three veterinary schools in the latter 1970s; and the 1980s will see another school or two. The Committee does not foresee a need for additional capacity for the production of veterinary graduates. In fact, one may expect some decrease in training capacity in schools that expanded substantially during the last decade under the stimulus of capitation funding; this decrease will occur as individual states assume more of the total responsibility for instructional costs and as they assess their own state and regional manpower needs. The total population of veterinarians in the United States in 1990 is expected to be as high as 53,000.

In addition to students seeking a veterinary degree, many students (about 20%) enrolled in U.S. schools of veterinary medicine are graduate or postdoctoral students. Of these, the largest group is composed of students with veterinary degrees who are seeking either an M.S. or a Ph.D., and the others are students who are seeking advanced training leading to board certification. Although the number of board-certified veterinary specialists has been increasing steadily over the last decade, the total number of such specialists in the entire profession is still just over 2,000 in 1981. Thus the profession has relatively few specialists overall, and the Committee recommends that veterinary schools place more emphasis on the production of specialty-trained veterinarians of all kinds, especially in those disciplines in which the schools have particular faculty expertise. Such training should be obtained where there are appropriate facilities and personnel with experience.

To predict the specialty disciplines most likely to be in demand through 1990, the Committee looked at several demand indicators, including the increasing numbers of veterinary specialty-board memberships, number and types of employment possibilities as indicated by advertisements in veterinary professional journals, and the types of disciplines needed as a result of legislation and regulations. The fields cited in all three of these categories are clinical medicine, epidemiology, laboratory-animal science, microbiology, pathology, and toxicology. Persons in these fields are predicted to be most in demand and should be strongly recommended for postdoctoral, Ph.D., and other training.

The Committee offers the following specific recommendations:

Recommendation 1: National Reporting System

The Committee recommends that a comprehensive national reporting system be developed to determine accurately the number of veterinarians being used in all fields of employment. This should either be an expansion of the existing AVMA system or be developed in conjunction with the existing system.

Recommendation 2: Stabilization of Number of Veterinary Graduates

The Committee recommends that educational opportunities at the D.V.M. level be stabilized at the current number. The number of veterinary graduates appears to be in balance with manpower and service needs. Schools adversely affected by the cessation of capitation funding should consider decreasing their enrollments, to maintain the quality of professional training and to be able to provide postdoctoral training for veterinarians needed by the non-private-practice sector. Increases to meet regional needs should be accompanied by decreases in regions that are training veterinarians in excess of their own needs. Other ways to stabilize veterinary manpower include early retirement, retraining in midcareer, and programs specifically designed to deal with regional imbalances in numbers of practitioners.

Recommendation 3: Veterinary Medical School Programs

a. The Committee recommends that the colleges of veterinary medicine adjust their curricula, admissions criteria, and clerkship programs to meet societal needs in environmental health protection, food production and protection, economic productivity in animal-related industries, biomedical research, and animal welfare, as well as needs for clinical patient care of animals.

b. The Committee recommends that national guidelines for postdoctoral educational programs at veterinary colleges be established. The AVMA Council on Education should create or sponsor a special group to develop guidelines and evaluate graduate programs according to those guidelines.

Recommendation 4: Support for Postdoctoral Training

The Committee recommends that postdoctoral training for veterinarians be given high priority for support by federal and state government agencies responsible for financing higher education.

Recommendation 5: Increased Recognition of Veterinarians as Biomedical Scientists

The Committee recommends that use of veterinarians' biomedical expertise by government agencies be increased. Agency heads should be made aware of the skills, knowledge, and unique qualifications of veterinarians, which could contribute to meeting the agencies' program goals and responsibilities. Thorough evaluation of the contributions and productivity of veterinary biomedical scientists in the fields of concern to federal and state agencies is encouraged to inform decisions about future selection of personnel from among the various health professional and paraprofessional manpower resources.

Recommendation 6: Participation of Veterinarians in Economic Modeling and Agribusiness

The Committee recommends that economic models be developed for the application of animal-health expertise to the livestock industries, possibly through the provision of expanded community or other agribusiness services. Multidisciplinary research involving veterinarians and agricultural economists should be encouraged.

Economic modeling is one technique that should be explored in an effort to deliver veterinary services to underserved areas.

1

INTRODUCTION

In April 1980, the U.S. Department of Agriculture (USDA), Food and Drug Administration (FDA), National Institutes of Health (NIH), Environmental Protection Agency (EPA), and U. S. Army Medical Research and Development Command (USAMRDC) asked the National Academy of Sciences to examine the impact of federal legislation and regulations on the national requirements for veterinary manpower. Accordingly, the Committee on Veterinary Medical Sciences of the National Research Council (NRC) Commission on Life Sciences was charged with assessing the effect of current legislation and regulations on the need for veterinary medical scientists with competence in various research and practice specialties, determining the distribution of the demand for such scientists and the capacity of the veterinary educational system for meeting the demand, and recommending ways to remedy present or potential manpower deficiencies.

The Committee identified three important issues in its early discussions. First, the implication of legislation and regulations on the need for veterinary medical specialists had to be placed in the context of other major demands for veterinary manpower, if it was to have meaning when embodied in specific recommendations. Second, as stated in legislation and regulations, the requirements could not be translated into exact manpower needs, because these depend on the amounts of funds appropriated to meet legislative goals and on the extent of the enforcement of legislation and regulations. Third, the Committee's task had been developed during a climate of increased government funding of regulatory activities, particularly biomedical and environmental, and this climate had changed suddenly to one of emphasis on reductions in government spending and on simplification of regulations; thus, manpower predictions based on earlier assumptions became very difficult. The Committee realized in its early deliberations that legislation and regulations constituted only one of several influences on veterinary specialty manpower.

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A special effort was made, in assembling the Committee, to ensure that its collective knowledge encompassed the types of expertise needed to conduct a study of this scope. The resulting multidisciplinary Committee includes members with professional experience in veterinary and human medicine, veterinary medical education, epidemiology, and research involving food animals, fur-bearing animals, and aquatic animals, as well as laboratory animals. The Committee members have served in industry, in public and private universities, in research institutions, in private practice, and in state and federal government agencies. Brief biographic sketches appear in Appendix H.

A broad search was conducted to gather the information that the Committee identified as necessary for its study. This effort went beyond a review of the published literature to include requests for information from federal and state agency officials, deans and department chairmen in medical and veterinary medical schools, representatives of academic and professional societies, representatives of industries that employ veterinary specialists, and consultants familiar with current legislative and regulatory requirements for biomedical manpower.

The Committee felt that the most valuable studies would be those which estimated the available pool of veterinary specialists, determined which kinds of employment were represented, determined whether some specialties were underpopulated, and--on the basis of both normal growth and the demands of legislation and regulations--predicted the demand for veterinary specialists in the future, at least until 1990.

The first step in providing a framework for analyzing the importance of and need for veterinarians' activities, as related to federal legislation, was to define the functional responsibilities of veterinarians. These responsibilities or functions represent avenues of impact of veterinarians and their activities on the people, the animals, and the environment of this country, and they are defined in Chapter 6.

The second step was to identify organizational settings and biomedical disciplines in which veterinarians currently perform activities related to the defined functional responsibilities. Concurrently, the numbers of veterinarians working in the organizational settings were identified.

The future needs for veterinarians in the various organizational settings were estimated on the basis of past and current data and the judgment of the Committee and others in industry, academia, and government agencies. The collected information is discussed in Chapters 9 and 10.

The next step was to examine the impact of federal legislation on the supply of and demand for veterinary medical scientists with competence in the various research and practice specialties. This analysis is developed in Chapter 11.

Finally, in Chapter 12, the Committee, through its deliberations and analysis of available data, agreed on specific recommendations that it thought were appropriate for consideration by three groups: the academic communities responsible for professional and postprofessional training of veterinarians, the public and private organizations that use the services and activities that can be provided by veterinarians, and the government and private organizations responsible for fiscal support of the other two groups.

OBJECTIVES

The Committee on Veterinary Medical Sciences was established in 1975 to provide a focal point within the National Research Council for all considerations related to veterinary medicine, and it was originally charged to concern itself with issues in which veterinary medicine played a role in biomedical research and development, with maximizing the participation of veterinary medical scientists in biomedical research and education, and with making the resources of the veterinary medical community available to the overall biomedical research effort. In Committee discussions, a three-part study was proposed and developed: an inventory and evaluation of the current research and educational role of the veterinary medical profession in the United States, identification of the principal present and future needs that veterinary medicine can help to meet, and recommendations on ways to meet these needs and on the appropriate policies for veterinary medical education. This report is a result of that study.

A number of surveys and reports during the last decade have addressed the future manpower needs in veterinary medical research and education in the United States and Canada. Some are discussed in this report, because their findings are related to the objectives of this study. In 1972, the NRC Committee on Veterinary Medical Research and Education completed a report, New Horizons for Veterinary Medicine.[1] It formulated recommendations on the modification and development of U.S. resources in veterinary medical research and education for future needs. Several other reports have since focused on the supply of and demand for veterinarians in 1990-1995. Their focus, recommendations, and conclusions have differed. For example, the A. D. Little report[2] projected an oversupply of veterinarians by the end of this decade, and a study[3] by the Health Resources Administration (HRA) of the Department of Health and Human Services (DHHS, formerly the Department of Health, Education, and Welfare) projected shortages by the middle of the decade. The USDA Coulter-Stanton study[4] supported the latter view. A more recent report by the HRA suggested "a possible oversupply of veterinarians in the future."[5] Because of some reservations about the methods and data bases used in these studies, specific questions have arisen. For example, does the projected oversupply or shortage apply to practicing veterinarians, nonpracticing veterinarians, or both? Definition of the term "oversupply" as used here can be ambiguous. For example, does it mean a lack of employment for veterinarians, a need to take employment in other fields, or reduced income? Do different subsets of the profession have different supply-demand projections? The disparate opinions expressed were of sufficient concern to warrant the present study.

This study was originally proposed and initiated under the title, "The Impact of Legislation and Regulations on the Need for Veterinary Manpower," with emphasis on the requirements for veterinary medical scientists in various scientific research and practice specialties. Representatives of federal agencies--particularly the USDA (which is the largest employer of veterinarians in the world), the FDA (which has the responsibility for ensuring the purity of food and drugs in the U.S. market), the EPA (which has a major responsibility for regulating toxic and hazardous materials in the environment), and the NIH and USAMRDC (major users of animals for biomedical research and for development of animal models of human disease)--expressed concern about whether enough veterinary specialists would be available for future needs. To respond to this concern, the Committee determined the current pool of veterinary specialists, i.e., veterinarians in fields other than private practice. This information is summarized in Table 9-1, and the sources are described in Appendixes D and E. The Committee also reviewed the legislation and regulations that have an impact on needs for veterinary manpower (Appendix B). Committee members worked with consultants to determine the types and numbers of veterinary specialists required by current and projected legislation.

The Committee found that implementation and enforcement of legislation have been much less than anticipated.[6,7] Because of rapid changes in regulatory policies, it was impossible to predict exact numbers of veterinary specialists to be needed in 1985 and 1990. The Committee and consultants did, however, correlate the current legislation with demand for additional veterinary personnel, both by discipline and by function, as described in Chapter 11.

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PREMISES OF THE STUDY

As the Committee began its study of the needs for veterinarians, it became obvious that a set of general assumptions concerning veterinary medical education, the structure of the profession, and the potential use of its resources by society had to be established as a basis for deliberation. The following premises were agreed on and used to form a basis for recommendations.

Clinical health professionals are distinguished by their specific clinical training, because their basic-science training is quite similar. Thus, physicians, dentists, osteopaths, and veterinarians are products of unique, although somewhat similar, training. The present and future goal of veterinary medical education is to provide a foundation in the basic sciences that is supplemented with clinical training related to animals. Veterinarians are therefore expected to demonstrate competence in both basic sciences and clinical disciplines.

Nonclinical biomedical scientists are usually identified by their basic-science training. They are often used in and contribute to teaching and research programs with health professionals. Biomedical scientists with postdoctoral training in activities related to veterinary medicine constitute an additional valuable resource for society.

The future role of veterinary medicine in society will reflect the profession's past and current activities. However, new career opportunities brought about by changing demands of society must be recognized and addressed. Curricula and training programs will need to be modified to adapt to new demands: students who will take advantage of these opportunities should be selected, and employers should be educated as to the merit of hiring veterinarians with special training and ability. Such curriculum changes, by necessity, will lead to both quantitative and qualitative modifications in the supply of and demand for veterinary specialists. For example, current concerns about environmental health have led to an increased demand for toxicologists and pathologists, and veterinary scientists are being sought for these roles, as shown in Chapter 10.

The primary role of veterinarians will continue to be to provide animal health-care services. General practitioners will continue to practice preventive medicine in herds and flocks and to provide care to individual animals. They will continue to protect the public from zoonotic disease and the food-animal industry from economic loss through disease, to care for the companion animals that provide emotional and mental health support to their owners, and to treat sporting animals. Clinical specialties have developed as natural outgrowths of sophisticated clinical veterinary medicine. Orthopedics, ophthalmology, surgery, internal medicine, and other clinical specialties are practiced in veterinary teaching institutions. Board-certified specialists are also beginning to practice in communities alongside general practitioners. Group practices with general practitioners and board-certified specialists are appearing, and society is well served by this growing mix of veterinarians in private practice and in teaching institutions.

The interests of society are also served by veterinarians in many fields other than direct patient care. Their strong basic-science education, coupled with skill in solving clinical problems, is a resource of value in many occupations, including toxicology, pathology, comparative medicine, food protection, environmental health protection, epidemiology, community and professional health education, and health-sciences administration. It is essential that veterinary medical educators select students capable of responding to society's needs for the practice of these occupations, provide strong basic-science education, and expose students to the new opportunities.

The Committee sees postdoctoral education as the responsibility of the entire scientific community. The type and quality of advanced training must be coordinated with perceived occupational needs. Veterinarians and other professionals and paraprofessionals with training in animal science should be encouraged to enter postdoctoral training programs in a variety of biomedical institutions, in addition to those in veterinary medical schools. Success in meeting society's needs will depend on the quality of postdoctoral training, as well as on the recipients' intellectual ability.

4

HISTORICAL PERSPECTIVE OF VETERINARY MEDICINE

In the 25-yr period beginning in 1852, six colleges opened for veterinary instruction and 1,267 veterinarians were graduated. In 1879, the oldest U.S. veterinary school that is still in existence was established at Iowa State University.[1] There are now 26 schools of veterinary medicine as shown in Appendix E, and others are being developed or planned. The AVMA was formed in 1863 and has provided leadership and set goals for education, research, and professional service in veterinary medicine.

The USDA Bureau of Animal Industry was formed in 1884. The work of the Bureau's T. Smith and F. L. Kilborne on Texas fever was an important contribution to biomedical research.[2] Their discovery in 1893 that insects transmit diseases led to the control and eradication of Texas fever in the United States and to the control of other insectborne diseases of man and animals.

Foot-and-mouth disease, perhaps the most serious disease of livestock, was first recognized in the United States in 1870. It has been reported eight times since then, most recently in 1929.[3,4] The disease was eradicated after each outbreak, and it has been kept out of the United States for over 50 yr. Other biomedical advances in veterinary medicine include the control of brucellosis and bovine tuberculosis and the eradication of hog cholera and vesicular exanthema.

Tuberculosis once was one of the most important diseases of man. The study of bovine tuberculosis contributed to the understanding of human disease, including gastrointestinal tuberculosis and its complications. In 1917, when a nationwide federal-state campaign of eradication began, 1 cow in 20 had the disease. The disease among cattle has now been virtually eliminated,[5] approximately 100 yr since the causative organism of tuberculosis was described in 1882 by Robert Koch.

In 1922, F. Schofield of the Ontario Veterinary College found that cattle that had eaten spoiled sweet clover died of massive hemorrhage.[6] His work led to the identification of a potent anticoagulant, dicumarol, now used throughout the world for the treatment of thrombotic complications of human cardiovascular diseases. Since then, animal models of the inherited and acquired bleeding disorders have been among the most successfully exploited models in comparative medicine. Such models have recently been used to elucidate the mechanism of von Willebrand's disease, a disorder found in pigs and many breeds of dogs, as well as in man, that is caused by a defect in plasma and platelets that prevents or delays hemostasis.[7]

There was little organized effort and funds were inadequate to control brucellosis until 1934, when a nationwide program based on testing and slaughter was started. Vaccination was introduced in the 1930s. In 1949, the milk ring test was initiated for testing of infected herds for brucellosis; by 1960, the proportion of reactor cattle had been reduced to about 1%.[4]

Investigations on avian tumors have played an important role in cancer-virus research. Although the transmissibility of avian tumors was shown early in this century,[8] one of the most notable events was the use of attenuated turkey herpesvirus as a vaccine against Marek's disease in 1970--the only vaccine currently available to protect an animal against tumors.[9]

O. Stader was the first to devise an external fixation splint for the treatment of fractures.[10] In 1941, the Navy accepted the design, and Stader's splint has since been in common use in human and animal medicine.

Hog cholera was first recognized in the United States in the 1830s. The hog cholera antiserum developed was a forerunner of serum-virus immunization. In 1951, modified live-virus vaccines were first used to protect swine against hog cholera.[3] Before the eradication program began in 1962, hog cholera cost the swine industry $50 million a year. The last known outbreaks in the United States are believed to have occurred in 1976; the disease has now been eradicated.

Until the late 1940s, veterinarians were trained and looked on as generalists. Veterinary specialization had its beginning when the American College of Veterinary Pathologists and the American Board of Public Health were recognized by the AVMA in 1951.[11] Veterinary groups with other common interests and skills, such as clinical specialization, have been created since then.

In 1954, the USDA Plum Island Animal Disease Center was established for the study of exotic diseases of animals.[11] The greatest achievement of this facility has been a foot-and-mouth disease vaccine produced through genetic engineering--the first effective vaccine against animal and human diseases prepared with gene-splicing techniques. The National Animal Disease Center was established in 1956. Efforts of the Center's 60 research scientists are devoted to the study of approximately 30 diseases of major economic importance affecting domestic animals.

Comparative medicine became an important field of study soon after World War II. New and valuable animal models of both naturally occurring and induced disease are being recognized continually.[7,12,13,14] Indeed, Rene Dubos of Rockefeller University (quoted in Leader[15]) pointed out that, "if we look carefully enough, we will eventually find an animal model for every disease."

In 1959, W. J. Hadlow of the Rocky Mountain Laboratory made the astute observation that sheep scrapie had similarities to kuru, a neurologic disease among primitive people of the eastern highlands of New Guinea.[8] This led to the discovery by D. C. Gajdusek and C. J. Gibbs that kuru was a slow-virus disease.[8,16]

The scientific community has long been aware of its scientific and ethical responsibility to provide new and better methods of animal care.[17] The increased use of animals for research resulted in the establishment of a number of organizations concerned with animal care.[18] The Animal Care Panel was probably the first of such groups; it became the American Association of Laboratory Animal Science (AALAS). In response to an increasing need, the American Association for the Accreditation of Laboratory Animal Care (AAALAC) was founded in 1965. The standards adopted by the Association for the care and use of laboratory animals are those contained in the NIH Guide for the Care and Use of Laboratory Animals.[17] The Guide is prepared for NIH by a committee of the NRC Institute of Laboratory Animal Resources and is updated at regular intervals. The stated policy of the NIH is to award funds for animal research only after the institution has filed a current assurance that the Guide requirements are being fulfilled. AAALAC accreditation is one way of providing such assurance. More than 600 institutions have sought AAALAC accreditation; as of March 1, 1982, 422 institutions were accredited.[19] Accreditation gives the public assurance that institutions maintain high standards of animal care.

The National Society for Medical Research was founded in 1946 to promote public understanding of the benefits gained through responsible animal experimentation in biomedical research and teaching.[18] The organization's goal is to ensure the freedom of researchers to use laboratory animals without unduly restrictive regulations. Other organizations whose goals are to ensure the humane use of experimental animals are the Scientists' Center for Animal Welfare, established in 1978, and the Association for Biomedical Research (formerly Research Animal Alliance), formed in 1979.

In 1966, the Animal Welfare Act was passed by Congress to ensure that animals used in research facilities, used for show purposes, or kept as companion animals are given humane care and treatment. The USDA is the regulatory agency. This subject has recently become a focus of public concern.[20]

Many regulations have been passed by government agencies to ensure the safety of drugs, devices, and radiologic and biologic products and the safety and wholesomeness of foods. These regulations have increased the demand for veterinary toxicologists and other veterinary specialists,[21] which is discussed in detail in Chapter 10 and in Appendix B.

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5

DELIVERY OF VETERINARY MEDICAL SERVICES

The Committee analyzed the activities of veterinarians to provide a framework for examining the needs for services that are and could be provided by veterinarians. It is important to remember that activities of veterinarians are usually multifaceted and have many impacts, resulting simultaneously in animal-health benefits, human-health benefits, and socioeconomic benefits. For example, veterinary participation in food-hygiene practice not only provides protection against the transmission of disease, but also assures consumers of products that are standard with respect to appearance, composition, and other criteria that may or may not affect health.

The skills and expertise of veterinary medicine are applied through private practice, institutional practice, preventive medicine, teaching and research, and industrial and international veterinary medicine. Each of these modes requires skills that veterinarians or equivalently trained professionals are uniquely qualified to provide.

PRIVATE PRACTICE

Private practice includes food- and companion-animal medicine. Food-animal medicine is one of the most important avenues through which veterinarians serve society. They serve agriculture and the nation in general by supporting efficient and economic production of meat, milk, eggs, and animal fiber. Food-animal veterinarians prevent, diagnose, treat, conduct research, and offer consultative services in health and production problems related to various species, including beef and dairy cattle, swine, sheep, goats, poultry, and fish. With increasing frequency, food-animal veterinarians are called on to offer herd-health management services in which preventive veterinary medicine plays a major role.

FOOD ANIMALS

Methods of food-animal veterinary practice are varied and currently include use of specially equipped mobile vehicles that are driven to farms to serve the animals. These vehicles are equipped to facilitate preventive medical care, as well as the diagnosis and treatment of diseases and injuries. Other practices use clinics to which animals are taken. These usually include facilities for consultation, clinical laboratory procedures, surgery, and radiology. Some provide for large-animal hospitalization. Most food-animal practitioners dispense pharmaceutical and biologic products, and some also offer preventive, diagnostic, and treatment services for companion animals.

The demands of the food-animal industry are such that veterinarians are called on to offer disease-prevention and disease-control services to an increasingly complex industry in which technologic change is rapid. To meet the needs, these services must be provided with minimal cost in time and labor and be coordinated with production schedules. Health-management practices are commonly influenced by market conditions and government policies. There is little opportunity for the care and treatment of individual animals. Delegation of routine technical procedures to paraprofessionals is common, whereas the services of qualified animal-health technicians are used to a very limited extent. Increased use of these technicians would enable practitioners to offer an even wider array of livestock-care services of higher quality than is now possible.

As farm units grow larger, food-animal veterinarians find themselves serving on management teams in support of production. Specialization by species is common, and such organizations as the American Association of Bovine Practitioners, the American Association of Swine Practitioners, and the American Association of Sheep and Goat Practitioners have evolved. Group practices allow for specialization and more effective use of experts, such as nutritionists, as part of the herd-health management team.

Food-animal practitioners assist in state and federal disease-control programs. Their activities include examination and certification of animal-health status for the movement of animals.

Veterinarians also assist, as paid consultants, in programs for the eradication and control of diseases, such as brucellosis and tuberculosis.

COMPANION ANIMALS

Companion-animal practice is designed to meet the health and behavioral needs of animals kept for companionship and to fulfill hobby interests of people. The importance of these animals to their owners is attested to by the long history of companion animals in association with the development of modern, advanced societies. Animals are believed to help in the emotional growth and psychologic stability of people of any age, but particularly of the young, the old, and the infirm. Some companion animals serve a dual purpose in working, as in guarding property and children. "Seeing eye" guide dogs and animal-herd dogs are other examples of working animals. Cats serve as companion animals and can act as aids in the control of rodents without resorting to potentially harmful poisons, particularly on farms and in rural households.

Companion-animal medicine includes the prevention, diagnosis, and treatment of disease problems of dogs, cats, horses, pet birds, hobby fish, and a variety of other animals kept primarily for the pleasure they bring their owners. Companion-animal practitioners commonly offer their services through well-equipped hospitals or clinics; few, if any, house calls are made. The American Animal Hospital Association certifies animal hospitals that meet its standards. Companion-animal practitioners perform all types of veterinary services, including medical and surgical procedures. Recently, there has been an increasing demand for specialization in clinical disciplines and along species lines--e.g., canine, feline, and avian medicine. The current trend is toward more group practices, sometimes involving a complete hospital facility surrounded by satellite clinics that offer restricted medical and surgical services.

Qualified animal-health technicians are used to a greater extent in companion-animal than in food-animal medicine. They provide a wide range of services in busy practices, helping to improve care and reduce costs.

Equine veterinary medicine falls generally into the category of companion-animal practice, in that it deals with riding, hobby, farm, and performance horses. Equine practitioners are usually specialists and work throughout the country in modern hospitals equipped to handle most medical and surgical needs involved in the care of horses. Horses also function as livestock or commercial animals and are treated by general practititioners in these instances.

INSTITUTIONAL VETERINARY MEDICINE

Institutional veterinary medical practice is the application of skills within the organizational structure of public and private institutions. This type of practice includes laboratory-animal medicine and zoo, aquatic, and wildlife medicine. Institutional veterinarians are employed by schools of veterinary medicine, medicine, dentistry, public health, osteopathy, pharmacy, and agriculture; state and local health departments; the military; agencies of the DHHS; the Veterans' Administration; colleges and universities; industries; research and development companies; private research institutions; primate centers; commercial laboratory-animal breeders; and hospitals. Responsibilities of laboratory-animal veterinarians include production and purchase of research animals; provision of appropriate housing and care of laboratory animals; preventive medicine; consultation on the selection, breeding, and use of defined and randomly procured research animals for specific purposes; diagnosis, control, and treatment of disease; research on disease and other health problems of laboratory animals; training of professional and nonprofessional staff in the proper use and handling of research animals; consultation on the planning of new animal housing and research facilities; and public education and liaison on matters related to the humane use of animals in health research. The opportunity to contribute to a wide variety of activities involving the use of laboratory animals is an ever-present challenge to laboratory-animal specialists.

Zoo and aquatic-animal veterinarians are in charge of the prevention, diagnosis, and treatment of diseases of a wide variety of the world's fauna. Although many principles of health management in these species are common to broad groups of animals, each species has unique characteristics that must be considered. Basic information on the normal physiology, environmental needs, reproductive cycles, and breeding of defined genetic stocks of wildlife is lacking, and the diseases of many of these species have received very little study. Thus, there are excellent opportunities for original contributions to science and to health-related fields through studies of animal-disease models in wildlife.

Wildlife veterinary medicine is closely related to the other types of institutional veterinary practice in many respects. However, it has the additional requirement that the practitioner be thoroughly familiar with the ecology of wildlife. Specialty training is usually obtained in departments of wildlife science. The principal duty of wildlife veterinarians involves population health problems, as opposed to the care of individual animals.

PREVENTIVE VETERINARY MEDICINE

Preventive veterinary medicine includes public-health practice, the regulation of food safety and quality, and military veterinary medicine.

Veterinary public health protects the health of man, with focus on the relationships of animal and human health and on the effect of the environment on human health. Public-health veterinarians plan, conduct, supervise, and coordinate community efforts to improve human health and safety. They are employed by local, state, and federal health agencies and in veterinary and other medical institutions. Specific responsibilities often include prevention and control of zoonoses, development of animal-disease reporting systems, inspection of foods and food-processing procedures to ensure food safety, control of radioactive hazards, control of urban and rural community-health problems, and administration and enforcement of specific health laws and regulations.

Public-health veterinary practitioners conduct epidemiologic research, using data collected from field studies or medical records. Other subjects of research are food safety and zoonosis control. Such research activity usually requires an advanced degree or training in veterinary public health and epidemiology.

Regulatory veterinarians are employed primarily by the USDA in the Animal and Plant Health Inspection Service (APHIS) and by state livestock-disease control agencies. These veterinarians are responsible for the administration of regulations intended to limit or eliminate the spread of disease from herd to herd and from one geographic area to another; such disease spread is one of the most important animal-health problems of the nation. Prevention of the spread of foreign diseases to domestic livestock is another of the important functions of regulatory veterinarians. Regulatory veterinarians are also responsible for the administration of the Animal Welfare Act.

The veterinary practice of food safety and quality control involves the antemortem and postmortem inspection of slaughtered animals, as well as inspection of food-processing procedures. Current concerns with regard to harmful residues in the human food supply make the effective and accurate inspection of all foods of utmost importance in the prevention of human disease. This function is performed by veterinarians employed in the USDA Food Safety and Inspection Service.

Military veterinarians are responsible for food inspection, control of zoonoses, laboratory-animal medicine, laboratory support of military medical services, and research and development. Limited opportunities are also provided for clinical practice. The health of military personnel is crucial in carrying out assigned missions, so veterinarians are of major importance. High-quality, safe food does much to improve and maintain the effectiveness of fighting forces.

Veterinarians are an integral part of medical research and development programs, serving in both administrative and investigative positions. Some subjects of research are the assessment of health hazards to the operators of weapons systems; blast overpressure of artillery systems; biologic effects of lasers and microwaves; vibration; toxicology; defense against biologic warfare involving infectious or toxic agents; research on combat trauma; heat, cold, and altitude stresses on man; and defense against chemical warfare.

Veterinarians in military service have a unique role. They bring a fundamental knowledge of comparative medicine, biology, and pathophysiology to the administration, operations, logistics, and research arms of the military services.

TEACHING AND RESEARCH

Veterinarians in teaching and research are employed in schools of medicine, veterinary medicine, dentistry, pharmacy, and agriculture; in departments of veterinary and animal science; and in colleges of arts and sciences (see Appendix E). Research veterinarians are also employed in such government agencies as USDA, EPA, FDA, and DHHS and by industrial companies. There are some opportunities for only teaching or research in a university, but most faculty requirements are for a combination of research, teaching, and possibly participation in continuing education, extension, and clinical responsibilities.

The teaching of veterinary medicine provides skilled veterinarians, but without past research the teachers would have little to teach; and without current research, the future scientific base of the profession would be in jeopardy, with resulting serious detrimental effects to society. Closely associated with the teaching and research needs of the profession are the graduate education functions of all biomedical institutions, including veterinary schools, colleges, and science departments.

Veterinary research has solved many of the important animal-disease problems that affect production agriculture, companion-animal health, and human health. This research, combined with the regulatory activities of USDA, has kept our animal agriculture industries relatively free of most of the world's major epidemic diseases. More efficient production and greater profits have been realized by the livestock and poultry industry from the maintenance of healthy animals and quality products to satisfy consumer demands for abundant supplies of high-quality, wholesome animal and poultry products at affordable prices.

Another contribution of veterinary research has been to the enjoyment of companion animals. In the last decade, the increasing numbers of clinical specialty disciplines and of veterinarians who complete clinical residency training in these specialties have brought the potential and quality of veterinary medical care for companion and other animals to a level similar to that of modern medicine. Controlled clinical trials with research animals have led to improved management and treatment of a variety of small-animal disorders (e.g., diseases of the eye and endocrine and reproductive systems). Important contributions have also been made in connection with animal diseases that are models of their human counterparts, especially if these disorders have a hereditary basis and can be reproduced for experimental studies. Thus, discovery and effective use of animal models of human disease have benefited both humans and animals.

Despite these advances, however, there are diseases that remain unchecked or are poorly recognized. They cause economic losses in animal food and fiber production, result in deficiencies in diagnostic tests for animal diseases, and present problems in the use of toxic chemicals and drugs throughout agricultural production systems, with serious implications for the quality of human food. Solutions to these problems will require new approaches to veterinary medical research. Three examples of recent scientific advances that may offer solutions are the application of hybridoma technology for production of large amounts of monoclonal antibodies, which can be used for more specific diagnostic tests and new approaches to immunologic research; genetic engineering and plasmid biology, which promise the development of new antigens for vaccines and diagnostic tests; and the increased technical sophistication in artificial insemination, embryo culture and transplantation, and hormonal regulation of growth and reproduction. Genetic research also promises the development of livestock breeds that are resistant to diseases for which vaccines or other satisfactory control measures are not available. Modern epidemiologic methods improve understanding of the multiple etiologic factors responsible for some production diseases and can provide strategies for the control of these diseases under farm conditions. Modern techniques in toxicologic research need to be applied to the elimination or neutralization of harmful effects of toxic chemicals and drug residues in animal products. Finally, integrated food-animal health systems are needed, so that available technology can be applied to the production process.

INDUSTRIAL VETERINARY MEDICINE

The application of knowledge developed through academic and industrial research and disseminated through the teaching efforts of colleges and universities to new animal-health product development and distribution is the primary role of industrial veterinary medicine. This profession includes research in the application of new technology to animal-health problems; development of vaccines, other biologics, and pharmaceutical agents; testing of these products for harmful effects in animals and potential harmful effects in man; research leading to the development of commercial production methods; field testing of new products; sales; technical assistance in the use of the products; and otherwise meeting the needs of product users. These types of problems are approached primarily by veterinarians with special training in pathology, toxicology, and laboratory-animal medicine. Exciting new developments in industrial veterinary medicine include the application of genetic engineering, plasmid biology, and hybridoma technology to the development of new viral, bacterial, and parasitic vaccines. The advantages of such vaccines include the presence of an abundant source of antigenic material devoid of toxicity and the existence of specific antigens that are free of contaminating tissue.

INTERNATIONAL VETERINARY MEDICINE

Most developing countries are in the tropical and subtropical zones. These countries are characterized by a scarcity of natural resources, poor use of available resources, large population relative to food supplies, and underdevelopment of educational opportunity. Their assets usually include arable land and pasture for livestock production. Realization of the potential of these agricultural assets, however, depends on the control of serious livestock diseases that limit production, including foot-and-mouth disease, rinderpest, African swine fever, trypanosomiasis and other hemoprotozoan diseases, gastrointestinal parasitic diseases, and diseases with a smaller impact on production, but with public-health implications, such as brucellosis, tuberculosis, anthrax, and rabies. Useful assistance to developing countries includes the provision of educational opportunities for their citizens, research in diseases peculiar to the area, and assistance in the control and eradication of epidemic disease. Because most of the serious problems are peculiar to the developing countries and are not present in the United States, support for research is usually provided as a part of international assistance programs. Some of the technical research can be done in research institutions in the United States, but applied research and field studies must be done in the country in question. These developing countries require assistance in the administration of control and eradication programs, because their experience and trained manpower are limited. Although living conditions may be less than ideal, the opportunity to contribute to the solution of problems of world hunger and to the education of youth in developing countries provides a challenge that makes international veterinary medicine unique and rewarding.

FUNCTIONAL RESPONSIBILITIES OF VETERINARIANS

The Committee defined functional responsibilities of veterinary medicine by looking at the variety of veterinary activities described above and using the approach of Anderson et al.[1] Although other specialists can assume some of these responsibilities, it is the veterinarian whose training is most directly designed to deal with them. The functional responsibilities of veterinarians are as follows:

- Administration: To serve as professional specialists and administrators in government health and environmental agencies and in industrial and other private organizations that provide preventive, diagnostic, treatment, research, and rehabilitative services for animals on a local, state, or national basis.
- Animal-health care: To protect and improve animal health by providing medical care for sick and injured animals.
- Animal welfare: To protect and improve the welfare of animals by providing increased information and services that assist in the prevention of disease and suffering in animals, including research animals.
- Biomedical research: To protect and improve animal and human health and welfare by developing knowledge through biomedical research and by developing, testing, and evaluating diagnostic procedures, drugs, prosthetic devices, chemicals, and biologics.
- Economic productivity: To promote the general economic productivity of animal-related industry and other business entities that depend on the prevention of disease in animals.
- Environmental health protection: To protect people and animals from environmental health hazards, particularly through monitoring, surveillance, and epidemiologic studies.
- Food production and protection: To ensure an adequate supply of foods of animal origin and to protect people from foodborne illness by detection and appropriate control of foods of animal origin that are unwholesome, diseased, or contaminated by physical, chemical, or biologic agents.

- Health education: To protect and promote human health and animal health by teaching in veterinary medical schools, medical schools, and public-health schools and by providing health education and consultation to animal owners, industry groups, and other interested persons.
- Mental and emotional health: To contribute to the emotional and functional well-being of people through activities associated with the care of companion animals, recognition of the motives for companion-animal ownership, and appreciation of the variety of emotional bonds that exist between companion animals and their owners.
- Zoonosis prevention: To protect people and animals from diseases transmitted between animals and people through the prevention, control, and eradication of these diseases (zoonoses), and the monitoring and surveillance of animals and people.

These functional responsibilities have been correlated by the Committee with the veterinary specialty disciplines defined in Appendix C. Table 6-1 displays the correlation. This analysis of functions and disciplines illustrates the wide variety of roles that veterinary specialists assume, and it demonstrates the close relationship of the veterinary profession with the other biomedical professions. Obviously, the manpower supply and demand problems of all biomedical specialties are intertwined and cannot be examined separately.

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TABLE 6-1

Essential Relationships Among Discipline and Functional Responsibilities of Veterinary Personnel[a]

Discipline	Functional Responsibilities: Administration	Animal Health Care	Animal Welfare	Biomedical Research	Economic Productivity	Environmental Health Protection	Food Production & Protection	Health Education	Mental and Emotional Health	Zoonosis Prevention
Biochemistry	X	-	-	X	-	-	-	X	-	-
Clinical specialties	X	X	X	X	X	X	X	X	X	X
Environmental health sciences	X	-	X	X	X	X	X	X	-	X
Epidemiology and preventive medicine	X	X	X	X	X	X	X	X	-	X
Ethology	-	-	X	X	-	-	-	X	X	-
Genetics	-	X	-	X	X	X	X	X	-	-
Immunobiology	X	X	X	X	X	-	X	X	-	X
Laboratory-animal science and support	X	-	X	X	-	X	-	X	-	X
Microbiology (bacteriology, virology, and mycology)	X	X	X	X	X	X	X	X	-	X
Molecular biology	X	-	-	X	-	-	-	X	-	-
Neurosciences	X	X	-	X	-	-	-	X	-	-
Nutrition	X	X	X	X	X	X	X	X	-	-
Parasitology	-	X	X	X	X	-	X	X	-	X
Pathology	X	X	X	X	X	X	X	X	-	X
Pharmacology	X	X	-	X	X	-	X	X	-	-
Physiology	X	X	-	X	-	-	X	X	-	-
Reproductive biology	-	X	X	X	X	-	X	X	-	-
Toxicology	X	-	-	X	X	X	X	X	-	-

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[a] X means that a majority of the Committee members believed knowledge of the discipline to be essential to performance of the function.

PREVIOUS MANPOWER STUDIES

In A Report to the President and Congress on the Status of Health Professions Personnel in the United States (1978) by the Health Resources Administration (HRA),[1] the following observation on existing manpower was made:

> Much of the data, information, and analyses needed to address more properly many of the current critical issues relating to the status of the health professions are either unavailable or outdated. Limited efforts have been undertaken in recent years to collect the needed data and to perform the necessary analyses. Because of the health care system's magnitude, complexity and importance, resolution of critical health manpower issues requires a much expanded information and analytical base.

The report noted further that the "immediate data and analytical needs on veterinarians are somewhat more critical than for other health manpower disciplines." This lack of needed data on the veterinary profession requires that a premium be placed on assessment and evaluation of relevant data that are available. This section reports an assessment of these data.

VETERINARY MEDICAL SCIENCE AND HUMAN HEALTH (1961)

Probably no study focused attention on the veterinary profession more effectively than that of the Subcommittee on Reorganization and International Organizations, chaired by Senator Hubert H. Humphrey. The report, Veterinary Medical Science and Human Health,[2] published in 1961, was based on contributions from many individuals and organizations in veterinary medicine. The finding that "experts report specifically that across-the-board shortages exist in veterinary medicine--in private practice, public service, education and research" had profound effects on veterinary medical education during the next 20 yr. In retrospect, the validity of the Subcommittee's findings can hardly be seriously questioned.

NEW HORIZONS FOR VETERINARY MEDICINE (1972)

A 1972 NRC report, New Horizons for Veterinary Medicine[3] (also known as the Terry report), was prepared from

> views solicited from a number of consumers or users of veterinary medical services--representatives of the USDA, the armed services, federal research and research training agencies, agricultural industries, medical schools, pharmaceutical companies, commercial banks especially interested in the agricultural economy, and public health agencies. These individuals were asked to define their interests in veterinary medicine and to evaluate the success of veterinary medical education in producing graduates that met their needs. They were also asked to estimate their future needs in terms of the quantity and quality of graduates in veterinary medicine in this country.
>
> Committee members visited a number of colleges of veterinary medicine in the U.S. and the three colleges in Canada. These visits made it possible to observe facilities and programs and to exchange views with faculty members and students. Discussions with university faculty members from outside the veterinary area were sought when it was felt that they might be valuable. Information thus gathered was supplemented by returns from a series of questionnaires and requests for specific information about faculty, students, budgets, facilities, programs, schedules, and related material. Not only colleges of veterinary medicine, but departments of veterinary science in colleges of agriculture were included in the search for pertinent information.

As a result of that study, the NRC Committee on Veterinary Medical Research and Education predicted a need for 42,000 veterinarians in 1980, but a supply of only 38,000--a deficit of 4,000. It estimated the supply for 1975 and 1980 on the basis of the number of graduates of U.S. veterinary schools and an assumed annual death rate of 1.3%. AVMA data show that there were about 35,500 veterinarians in 1980.[5] The study also predicted substantial increases in manpower needs in all sectors of veterinary medicine except food-animal practice and military veterinary medicine.

The strength of the NRC study was the variety of input. The report offered recommendations as to how U.S. resources in veterinary medical research and education could most effectively be modified and developed to meet future needs by capitalizing on the best features of the existing framework. These projections are of only limited value today, because they refer to data collected for 1970 and extrapolated through 1980. In addition, anticipated and unanticipated changes in manpower supply and demand have occurred and have caused some needs to be much lower than estimated. For example, dramatic increases in the use of paraprofessionals in regulatory veterinary medicine and meat inspection left a need for fewer than 50% of the veterinarians estimated to be needed in these roles. The recent phasing out of the Air Force Veterinary Corps and reduction in Army employment of veterinarians also changed predicted military veterinary manpower needs. Other concerns about the study were the subjective nature of the data and the relatively small data base.

In 1980, there were approximately 35,500 active veterinarians in the United States and its possessions, which is somewhat below that predicted in the NRC study. The number of veterinarians engaged in large-animal and mixed practice, part-time or full-time, increased from 8,857 in 1970[4] to 13,993 in 1981.[5] The apparent differences between predicted and actual supply and demand in large-animal and mixed-practice veterinary medicine are related in part to the fact that the NRC predictions[3] were in full-time equivalents, whereas manpower increases noted in the AVMA directories[4,5] could not be calculated that way. Reliable estimates of full-time equivalents in large-animal and mixed practice are not available from current data. Whether the projections in the NRC study of future needs for veterinarians were accurate is still debated, as seen from the studies described below.

VETERINARY SUPPLY AND DEMAND IN THE UNITED STATES (1978)

The AVMA contracted with A. D. Little, Inc., for the study Veterinary Supply and Demand in the United States, published in 1978.[6] Of those surveyed, 2,153 private veterinary practitioners, all schools of veterinary medicine, 24 departments of veterinary science, 65 medical schools, and 48 state veterinarians responded. The present and future supply of and demand for veterinarians in each sector were assessed. To estimate demand, A. D. Little analyzed social, economic, and agricultural factors that were demonstrably related to demand and projected them into the future. Where possible, it developed econometric forecasting models; in other instances, it used its own analysis of the factors underlying demand and surveys of knowledgeable people. A. D. Little forecasted supply on the basis of the current age distribution of veterinarians, retirement and mortality rates, graduates from schools of veterinary medicine, and certified foreign veterinary graduates. During this study, from April 1977 through June 1978, it worked closely with the AVMA's Manpower Advisory Committee and staff.

An overall balance was found between the supply of and demand for veterinarians in private practice in 1977. There was a slight shortage in educational institutions and a substantial shortage in industry. Both shortages stemmed from an insufficiency of veterinarians with postgraduate training.

A. D. Little researchers forecasted that, with the 22 schools of veterinary medicine present in 1977 and 2 new schools "on line," there would be at least 53,000 nonretired veterinarians in the United States by 1990. About 49,900 of these would be available to provide veterinary services. Four other schools of veterinary medicine, if completed as planned, would increase the total supply by 1990 to about 54,900 and the available supply to about 51,100. In the report, the actual and projected numbers of graduates of U.S. veterinary schools were compared at 5-yr intervals with the U.S. population, personal expenditures, and medical-school graduates. The A. D. Little study forecasted a demand of only about 41,600 veterinarians by 1990, leaving a surplus of at least 8,300. Even by 1985, it projected a surplus of about 3,900, assuming 24 schools in operation. Whether this means a prediction of joblessness among veterinarians or a reduction in their earnings is unclear. Demand for veterinarians for economic (food and fur-bearing) animals was estimated to remain stable for the United States as a whole (demand in 1977, 6,035; demand in 1990, 6,064).

The study forecasted that the demand for veterinarians with postprofessional education and training would rise more steeply than the demand for those with only a veterinary degree. The estimates indicated that there may be a demand for as many as 5,500 additional veterinarians with postprofessional training between 1977 and 1990. The same study estimated that the supply of veterinarians with postdoctoral training would fall short of demand by 360 during the period 1977-1980 and by 250 during the period 1977-1985. By 1990, it was estimated, the additional supply would exceed demand by 450.

The study by A. D. Little was strong in its estimates of supply. Its weakness was that most of the demand data were generated from contacts with members of the veterinary profession, as opposed to users and potential users of veterinary services; thus, the respondents may have lacked objectivity. For example, the prediction of the number of veterinarians needed by the FDA was based on the number of authorized employment slots available, and not on the number of veterinarians employed at the time (87 slots were authorized in 1978 by the FDA, but only 74 veterinarians were employed).

Projections for manpower needs beyond 5 yr have tended to be of limited value here and in other surveys, such as the Terry report. Because projections are used frequently by government funding and other agencies for fiscal and organizational planning, they become self-fulfilling. The negative impact of such projections is seldom recognized in time to permit remedial action.

REPORTS BY THE HEALTH RESOURCES ADMINISTRATION (1978, 1980, 1982)

A report by the HRA[1] projected manpower needs on the basis of the

Project Supply Output and Requirements (SOAR) model developed by the Manpower Analysis Branch, Bureau of Health Manpower. The model was conceived to respond to the question of how much manpower would be required by the future health-care system under various specific conditions. The developers selected a demographic projection method. With this method, the SOAR model projected U.S. population by age, sex, and income group to 1980, 1985, and 1990. For each population group, a use rate for each of 18 types of health-service setting (general medical-office visit, inpatient hospital admission, nursing-home stay, etc.) was estimated from recent National Health Interview Survey data and other sources. The ratio of active veterinarians was projected to reach 16 per 100,000 of population in 1980 and 19 per 100,000 in 1990, compared with 13 per 100,000 in 1970.[1]

The foregoing procedure was the first stage, or "framework" phase, of the model. In the second stage, the model incorporated changes in use that largely represented a continuation of recent trends in the delivery of care. In an effort to avoid the problems of trend models, the model introduced adjustments for past changes in consumer prices for various health services, coupled with changes in per capita use.

The study projected a shortage of veterinarians through the mid-1980s and a surplus by the late 1980s. The supply was projected to reach 54,900 in 1990, with an estimated requirement of 52,300 for that year. An updated version of the 1978 HRA report in 1980[7] called attention to the marked increases in veterinary-school enrollments:

> Between 1970-71 and 1978-79, first year enrollments in schools of veterinary medicine increased from 1,430 to 2,041 and total enrollments increased from 5,006 to 7,294. Enrollments are expected to continue to increase through the early 1980s as recently established schools expand to capacity and several new schools are opened. Because there is growing concern that further increases in the number of schools will lead to an excess supply of veterinarians, other proposals for new veterinary programs probably will meet growing opposition.

The supply of veterinarians increased by 32% between 1970 and 1978--the highest increase among the health professions. In contrast, physicians increased by 17% during the same period.[7] Projections made in 1982 by the HRA[8] regarding health manpower in 1990 and 2000 showed modest surpluses in all health professions, including veterinary medicine. However, there were marked regional differences in demand, so some imbalances are likely to occur. Because specialty-trained veterinary manpower is the subject of this report, the supply of and demand for veterinary specialists will be looked at in more detail in Chapters 9 and 10.

The strength of the studies by the HRA was the method used, which included the SOAR model. The projections, however, were heavily oriented to the population base, so they may predict needs for companion-animal practitioners, but be much less useful in predicting needs for large-animal and mixed-practice veterinarians.[9] Although current figures indicate that about 24% of veterinarians participate in non-private-practice activities, p. X-11 of the latest HRA report[8] stated that specialty training in some fields continues to grow substantially, but that that is likely to have a negligible impact on the total needs for veterinarians. Areas underserved by veterinarians are currently identified on the basis of ratios of veterinarians to animal units.

GRADUATES OF HIGHER EDUCATION IN THE FOOD AND AGRICULTURAL SCIENCES (1980)

The report Graduates of Higher Education in the Food and Agricultural Sciences,[10] published in 1980, used data on degrees conferred in 1977 from the National Center for Education Statistics to examine supply and employment data from the Bureau of Labor Statistics and Department of Defense and to make demand projections through 1985. A USDA-funded Clemson University project on professional employment in teaching and research in higher education was also used as a data base for college and university faculty.

The major source of employment data was the Occupational Outlook Handbook of the Census Based Program, Bureau of Labor Statistics.[11] Current occupational employment was computed from the data base, and average annual openings through 1985 were then projected. An average annual demand for 1,448 new veterinarians in private clinical practice was found. The average annual supply of 1,291 graduates calculated in this study would satisfy 89% of the demand.

The study showed imbalances in the supply of and demand for graduates of higher education in the food and agricultural sciences. Through the mid-1980s, estimated supplies of associate and baccalaureate degree recipients appeared to be adequate for most employment demands. However, current and projected supplies of graduates with advanced degrees did not appear to satisfy employment demands.

Strengths of the study were the different data bases used in making projections and a rolling projection horizon. Weaknesses were the heavy reliance on past employment demand and supply data to project future needs and the lack of specificity in job titles. Another weakness in the accuracy of predictions for veterinary medicine (Table 29, p. 62 of the report) is that data were extrapolated on the basis of a 50% response rate. Thus, absolute numbers for average annual faculty openings were underestimated by a factor of 2, compared with actual data available from the AAVMC.

VETERINARY MEDICAL MANPOWER: SUPPLY-DEMAND PROJECTIONS TO 2020 (1976)

A study by McLaughlin et al. projected a shortage of veterinarians through 2020.[12] A model developed to predict supply of veterinarians included projections of veterinary-school enrollments, class attrition, deaths, retirements, nonavailablity to provide veterinary services, and withdrawal from the profession. This model was essentially the same as that used in 1978 by A. D. Little,[6] except that the latter used another input factor: an estimate of the number of foreign graduates assumed to enter the pool each year. Need was estimated as proposed in the Humphrey report at 17.5 veterinarians per 100,000 population in 1980, and this estimate was then increased at 0.6 per 100,000 population per decade to adjust for the expanding role of veterinary medicine in society. It was estimated that about 32,000 veterinarians would be available in 1980, 36,000 in 1985, and 40,000 in 1990. These were estimates of available manpower, not estimates of total manpower in the Terry report. By contrast, the 1978 A. D. Little study predicted a supply of about 34,500 available veterinarians in 1980, 41,800 in 1985, and 49,900 in 1990.[6] The strength of the McLaughlin study was the scientific approach used to estimate the future supply of veterinarians. A weakness was the use of the empirically derived 17.5 veterinarians per 100,000 of population.

ASSESSMENT OF NATIONAL VETERINARY MANPOWER STUDIES

Review of the manpower studies concerning predictions of veterinarians available in 1980 showed minimal differences in comparison with the actual number present. However, there are major discrepancies in the various predictions of supply in 1985 and 1990. These differences probably reflect the assumptions chosen as a basis for the predictions. For example, the McLaughlin study did not include foreign graduates in the pool, whereas the A. D. Little study did. The latter study assumed that 100 new foreign graduates would be added to the pool per year from 1978 to 1985 and that thereafter 180 new foreign graduates would be added per year.[6] Those additions are equivalent to adding the products of two new veterinary schools each year, whereas actual data for current years indicate that fewer than 70 foreign graduates are awarded equivalency certificates per year.[13] The A. D. Little study assumed that veterinarians have a lower death rate than the population as a whole. The McLaughlin study used standard mortality tables, because there was no reason not to. The retirement rates used by A. D. Little distributed around a mean of 65 yr of age, with all members retired by age 76; McLaughlin _et_ _al_. used a Poisson distribution for retirement, with a mean of 62 yr and with all retired by age 71. Thus, different assumptions can lead to disparate conclusions for the same population. This problem created considerable difficulty for the Committee in its analysis of existing data and its generation of assumptions and predictions.

Given the current projected output of U.S. veterinary schools (Chapter 9), the current number of foreign graduates entering the pool each year, and assumptions between those of McLaughlin[12] and A. D. Little,[6] we can expect about 45,000 veterinarians to be available in 1990.

Of reports of studies that developed substantial data on national veterinary manpower needs, the reports Veterinary Medical Science and Human Health[2] and New Horizons for Veterinary Medicine[3] are out of date; they were not intended to project needs into the 1980s. The A. D. Little study and studies by the HRA Bureau of Health Manpower[1,7] predicted a surplus of veterinarians by the late 1980s. These studies and the HRA report on the food-animal veterinarian shortage[8] differed with regard to the supply of and demand for food-animal veterinarians. The A. D. Little report projected little or no increase in demand--that was in keeping with earlier projections in New Horizons for Veterinary Medicine.[3] The 1978 HRA report,[1] however, identified a shortage of food-animal veterinarians and cited a growing problem in specialty and geographic maldistribution, i.e., a shift of veterinary manpower toward companion-animal medicine and away from food-animal medicine. This was also emphasized in the 1982 HRA report.[8] The significance of the increase in numbers of veterinarians (not necessarily full-time equivalents) in large-animal and mixed practice reported by the AVMA is not clear.[4,5]

The report by the USDA Science and Education Administration[10] identified shortages of practicing veterinarians and faculty through 1985. The projected need for practicing veterinarians was based on an overconservative supply estimate that did not account for new schools that had not yet graduated a class. If calculation had been based on current supply data, they would have predicted a surplus of supply relative to demand for practicing veterinarians.

Despite the different methods used and the disparate conclusions, if confidence intervals were available and applied to the previous manpower reports, they might all agree. However, without validation of their assumptions, there is no way to gauge the accuracy of their conclusions.

Several additional statements of need for veterinarians have been made. A statement prepared by the Joint Committee on Veterinary Education of the AVMA and the AAVMC, Veterinary Medicine: A National Resource and a National Responsibility,[13] contained useful descriptive information concerning the profession. This and similar statements relied on data referred to elsewhere in this report for projections of supply of and demand for veterinary services.

In summary, studies have suggested that an approximate balance in supply of and demand for veterinarians in clinical practice in the nation as a whole will occur in the 1980s. There may continue to be shortages in some specialties, such as food-animal practice, and in regions of the country that depend heavily on services provided by specialty groups.

With respect to the supply of available veterinarians in the non-private-practice sector, predictions of the previous manpower studies were gross overestimates. The Terry report found 8,425 veterinarians in non-private-practice endeavors in 1970, of a total of 26,602--i.e., 32%, compared with 68% in private practice. In 1981, the AVMA reported 26,871 (76%) of veterinarians in private practice and 8,464 (24%) in other functions. Our current figure of 8,760 for 1981 (Table 9-1) is in close agreement. These data demonstrate a significant increase in the demand for direct patient-care services over the last decade at the expense of other veterinary activities. Whether this reflects the economic disadvantages of non-private-practice careers or a stable demand for such positions remains to be determined. Certainly, fewer veterinarians are available to fill the needs of the non-private-practice sector, which has to resort to hiring other health professionals and paraprofessionals to meet the need.

The Terry report predicted a demand for 12,183 veterinarians in the non-private-practice sector by 1980. The actual figure of 8,824[5] is far short of this prediction. Thus, nearly 3,400 employment possibilities for veterinarians predicted earlier were not realized. The data are even more striking when one remembers that during the 1970s the number of veterinary-school faculty members increased from about 1,600 to 3,300 and that about 75% of these persons are veterinarians. Thus, nearly 1,500 more employment possibilities have been lost, compared with the prediction for the nonacademic institutional, non-private-practice sectors.

The imbalance in supply of and demand for veterinarians with advanced training identified by A. D. Little in 1977, is cause for concern. These specialists provide the manpower for diagnostic laboratories, animal-health research, and animal-disease control, which are of utmost importance to the livestock industries, and for basic biomedical research, for which animal studies are critical. The shortage, although crucial, would be alleviated only indirectly and modestly by new opportunities for professional study. Direct and substantial alleviation of the shortage would come through increased opportunities for postdoctoral training. Although a supply-demand balance by 1990 was projected in the A. D. Little study, the demand is highly elastic and depends heavily on the extent of funding by federal, state, and local governments.

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METHODS OF THIS STUDY

The purpose of the work of this Committee has been to define the impact of federal legislation on the need for health-related services that are provided by veterinarians or equivalently trained professionals. It is incorrect and simplistic to look at the functions performed by veterinarians as though they have an impact on either animal health, or human health, or consumer protection, or economic productivity--in reality, they have these effects concurrently. It is equally incorrect and simplistic to look at contemporary functions of veterinarians as fitting exclusively into the traditional academic disciplines or practice specialties of pathology, toxicology, food hygiene, microbiology, companion-animal practice, etc., and then to relate these individually to federal legislation. Because of the complexities of the subject, the Committee used a variety of methods in this study.

The Committee adopted the format and rationale provided by Anderson *et al.*[1] as the basis for organization and classification of data. The system provided by Anderson *et al.* was developed in the context of contributions to human health. Some modification was deemed appropriate by the Committee, but, because most legislation studied by the Committee has the objective of improving or protecting human health or the environment in which humans live, the model was deemed exceptionally appropriate as a base. Ten functional responsibilities were defined in this process. Next, the Committee identified organizational settings and biomedical disciplines in which veterinarians currently perform activities related to the defined functional responsibilities. The biomedical disciplines are defined in Appendix C. Concurrently, the numbers of veterinarians working in the organizational settings were identified. The sources for this identification are described in Appendixes D and E.

In estimating the future needs for veterinarians in the various organizational settings, two approaches were used. The first was to plot the number of veterinarians used in one of the major organizational settings (veterinary schools) over the last 10 yr and then to project the employment curve through 1990 according to the method of Allen M. Singer.[2] The second approach was to use the expert judgment of consultants representing industry, academia, and government as well as classified advertisements (Table 10-11) to estimate the current and future needs for veterinarians.

The Committee decided that it was necessary to obtain as accurate a count as possible of veterinarians serving in activities other than private practice (Tables 9-1 and 9-2). To obtain these data, various sources were used, including direct inquiries of the agencies, schools, departments, and industries where possible, and data from professional associations, such as the AVMA, AAVMC, AAMC, and the National Association of Federal Veterinarians.[3-9] Estimates and projections were also used. The data shown in Tables 9-1 and 9-2 are discussed in Appendix D. Relatively complete data were available for 1970, as cited in the Terry report;[3] additional data for 1977 were available in the A. D. Little report;[4] and additional data for 1981 were gathered by the Committee. Most of the data from the intervening years are not available. Where possible, estimates were made by using a composite of available sources; a complete description of methods appears in Appendix D, and additional sources are presented in Appendix E.

The current numbers of veterinarians serving in each of the various employment sources in 1981 were used as a baseline for projections of future needs. The assumptions used included faculty needs at veterinary medical schools, population growth, funding of federal programs, and demand created by legislation and regulations. Excellent data were provided by the AAVMC, so projected needs for faculty at veterinary medical schools could be analyzed in detail to learn the magnitude of expected demand for veterinarians in that sphere.

In other occupational settings, such projections were not possible for several reasons: lack of time-series employment data over a number of years, small sample size, and lack of consistent data on correlated factors, such as funding. In such cases, interviews were held to find out what functions and activities were being carried out or planned in which veterinary specialists either were or could be employed. A large number of specific disciplines were found in which veterinary specialists were employed.

The Committee analyzed these major biomedical disciplines in which veterinarians are currently active in research, teaching, administration, or other capacity. The list of disciplines was then used in the analysis of selected legislation to determine which disciplines were needed in the implementation of the legislation. Some disciplines are used widely and therefore are in greater demand than others. This analysis is discussed in Chapter 11.

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9

A MODEL FOR SUPPLY AND DEMAND IN SCHOOLS OF VETERINARY MEDICINE

Table 9-1 lists sources of veterinary employment in the non-private-practice sector according to five categories: academic institutions, federal government agencies, state government agencies, industry, and nonprofit institutions. Determination of the current levels of employment in several subdivisions of these categories proved difficult but informative. It was difficult because no centralized reporting of veterinary manpower use existed that provided an exhaustive and exclusive classification of veterinarians; it was informative because the results obtained from detailed discussions, validation, and cross-referencing of all data sources established the best available current figures for 1981. The sources of data are documented in Appendix D.

The data for 1981 (Table 9-1) show that a total of 3,337 veterinarians were employed by academic institutions. Of these, 2,567 (76.9%) were at veterinary schools, and the next largest group, 406 (12.2%), were at medical schools. Another 287 (8.6%) were at colleges of agriculture and veterinary science. Thus, close to one-fourth of the academic veterinarians in the United States were at institutions other than veterinary schools.

The second largest employer of veterinarians not in private practice was found to be the agencies of the federal government. Of the 2,906 veterinarians identified in this sector, 2,126 worked for various subdivisions of the U.S. Department of Agriculture; the 577 employed by the Department of Defense constituted the next largest group. The third largest group, with 159 veterinarians, was the Department of Health and Human Services. The remaining groups each accounted for 13 or fewer veterinarians. These data on federally employed veterinarians appear to be the most reliable and were the easiest to obtain and verify.

The total number of veterinarians employed by state governments was found to be 745, but the figures were by necessity extrapolated from several sources. Data on industry and a collection of nonprofit institutions were even more difficult to obtain and verify. Collectively, these categories represented about 1,800 persons. Data on the avian pathologists (100), zoos and aquariums (110), primate centers (33), and private diagnostic laboratories (29) are highly reliable, but the remainder should be viewed only as reasonable estimates.

Table 9-2 lists the available time-series data on the use of veterinarians not in private practice during the last decade. The sources of data are documented in Appendix D. These time-series data were required for development of the model for future demand used in Figures 1-5. Our results were disappointing, however, because reliable data could be obtained for most years of the decade for only 10 of the 20 federal government subdivisions and only 4 of the 17 nonfederal government categories. The usefulness of these data for projecting manpower needs was obviously compromised as a result of these large data gaps.

Despite the above reservations, reasonable estimates of time-series data were possible for the 14 categories in which a minimum of information was available on at least four consecutive years. Results show that the number of veterinarians employed at medical schools has increased slowly but steadily since 1972 (an average annual growth rate of 2.5%).

Data on veterinary school faculty have been collected by the AAVMC in a consistent fashion since 1974. Unfortunately, these data do not distinguish between faculty members with and without the veterinary degree; again, extrapolation is necessary for this very large segment of the non-private-practice sector of the profession. Personal contacts made with each school indicated that, on the average, 77.6% of faculty members were veterinarians. Application of this percentage to the reported time-series values permitted a reasonable estimation of the actual numbers of persons. The large increase in the number of veterinary schools since 1974 is also reflected by the trend data. In 1974, an estimated 1,574 veterinarians were on veterinary school faculties, compared with the current estimate of 2,567 for 1981.

The most reliable time-series data were obtained on the federal government agencies. However, the frequent changes in reporting categories from 1970 to 1981 preclude establishment of complete serial data on all 20 categories that are now being reported. Also, no data were collected or are available for 1976-1978. The total number of veterinarians employed decreased from 3,426 in 1970 to 2,908 in 1981. The bulk of the decrease occurred in the Department of Defense--from 999 in 1970 to 577 in 1981. The Department of Agriculture figures remained roughly stable from 1970 (2,254) to 1981 (2,126). Thus, this Department remains as the largest government employer of veterinarians.

Employment by other federal agencies remained remarkably constant during these 11 yr. This result was unexpected, in view of the apparent increase in the role of government in our society. Of the remaining nongovernment categories, only the avian pathology, zoo, and aquarium groups could be studied sequentially. The former was stable at about 100 persons since 1972, whereas there was a slow but steady increase in veterinarians working solely at zoos and aquariums--from 54 in 1970 to 110 in 1981.

In summary, the Committee has examined all available data sources in great detail and has concluded that a reliable historical data base on veterinarians in the non-private-practice sector does not exist. That limits the reliability of demand projections based on past employment practices for all categories.

SUPPLY: VETERINARY GRADUATES OF U.S. SCHOOLS OF VETERINARY MEDICINE

Of the estimated 25% of veterinarians who are not in private practice,[1] those employed in schools of veterinary medicine constitute the second largest group, just behind those employed by federal and state governments (Tables 9-1 and 9-2 and Appendix E). It is important to study the academic group, not only for this reason, but also because this sector is crucial to the future supply of veterinarians. This section examines the data available from the AAVMC on enrollments, faculty, and expenditures during the period 1970-1981 and provides estimates of the potential employment for veterinarians that can be expected from these institutions in the 1980s.

The AAVMC has collected the data through an annual survey of U.S. and Canadian veterinary medical schools,[2] but the Canadian schools are excluded here. The amount and types of data collected have varied over the years, so we do not have a complete time series on all the items. Nevertheless, this is the most comprehensive source of data available on veterinary medical schools. The data relevant to this analysis are presented in Tables 9-3 to 9-5.

In 1970, there were 18 U.S. schools of veterinary medicine. By the fall of 1981, there were 26 schools (listed in Appendix E) and data from 25 of these schools is included in the AAVMC Comparative Data Report for 1981.[2] Several more schools are being formed and are likely to begin operating soon. The projections of enrollments, faculty demand, and expenditures discussed here are contingent on the Committee's expectation of how rapidly and to what extent the expansion of schools will continue. For the rest of the 1980 decade at least, the Committee does not foresee any appreciable enrollment growth in U.S. veterinary schools. Its estimate of the upper limit of enrollment growth through 1990 is 1%/yr, its estimate of the lower limit is -1%/yr, and its best guess is zero growth (Figure 9-1).

The total number of veterinarians (including AVMA members and nonmember respondents to the AVMA directory survey) in the United States and its possessions has increased from 25,125 in 1970 (as shown in the Terry report[3]) to 35,335 in 1981.[4] The number in private practice has increased from 17,462 (69.5%) to 26,871 (76.0%) in the same period. Thus, the percentage available for all other needs of society has decreased from 31.5 to 24.0 during this period, and there has been a modest overall increase, from 7,663 to 8,464 in the number of veterinarians active in settings other than private practice, as determined from the AVMA data sources.[3,4] The latter figure agrees favorably with the current study (Table 9-1), which identified 8,760 veterinarians engaged in activities other than private practice.

POSTDOCTORAL TRAINING

Although the number of undergraduate veterinary students appears to be leveling off, the greater emphasis on graduate education in various clinical and research disciplines within veterinary schools is likely to continue at least for the next decade.

Of the students enrolled in U.S. schools of veterinary medicine in 1981, 83% were undergraduates seeking veterinary degrees, and 17% were graduate students seeking advanced degrees or certificates of advanced training (Table 9-3). Of the latter, the largest group was composed of students with veterinary degrees seeking either an M.S. or Ph.D. The remaining groups consisted of other graduate students seeking advanced degrees and veterinary graduates seeking certificates of internship and residency. Of veterinary students enrolled in 1981, 63% were male and 37% female;[2] that represents a considerable increase in the number of women entering the profession today, compared with the private-practice (10%) and non-private-practice (9%) sectors.[4] The impact of this rapid change in sex distribution has yet to be determined.

During the last half of the 1970s, there was a slight but perceptible shift toward graduate study;[2,5] after 1974, the number of graduate students grew twice as fast as the number of undergraduates. The fastest growth occurred in the number of veterinary graduates in internship and residency programs, and particularly in women graduates entering these programs. Perhaps that signifies a tendency to increased specialization within the veterinary profession. The Doctorate Records File maintained by the Office of Scientific and Engineering Personnel, National Research Council, records all students receiving Ph.D. degrees and also indicates degrees previously held by new doctoral recipients. In 1970, of 19,500 doctorates issued, 110 held a veterinary degree. In 1979, of 30,875 doctorates issued, only 75 had veterinary degrees. This downward trend is confirmed by data on the intervening years. By comparison, specialty-board memberships have increased considerably during this period (see Table 10-10); this may partially explain the reduction in the number of Ph.D. degrees sought.

The current disparity between salaries for veterinarians and those of other health professionals[5] may be an important drawback to those considering advanced specialty training. The recent report by the NRC Committee on a Study of National Needs for Biomedical and Behavioral Research Personnel[5] compared the net loss in lifetime income associated with postdoctoral training and entrance into non-private-practice careers for physicians, dentists, and veterinarians. "Compared to physicians and dentists, veterinarians have small economic losses, whether employed by the federal government or a veterinary school" (p. 29). On a percentage basis, however, physicians and veterinarians employed in academic institutional settings earned 77% and 90%, respectively, of the private-practice average in 1977, for which comparable data are available.[5,6] The percentage difference was similar (10%) for veterinarians in 1980.[6] Thus, although the statement in the above quotation is true when actual dollar amounts are compared, the relative loss to veterinarians pursuing non-private-practice careers is still of concern and should not be overlooked, because the profession as a whole earns considerably less (by about half) than either physicians or dentists.[5,6] Thus, this statement and the related conclusion about stipends for veterinarians in training (p. 30) are not truly representative of veterinarians' status or needs.

FACULTY

About 3,300 academic and professional personnel (excluding interns and residents) were employed by U.S. schools of veterinary medicine in 1981 (Table 9-5). This total, which we will denote as "faculty," even though many do not have full faculty status, includes persons at all ranks from lecturer and associate through administrator. Exact data are not available on the types of degrees held by these faculty members, but the number holding veterinary degrees can be estimated from data collected by this Committee and indicated in Appendix E, Table E-1. In 1981, about 78% of all academic and professional personnel in veterinary medical schools held veterinary degrees--about 2,567 persons, apparently fairly close to the number estimated by A. D. Little[1] (roughly estimated from the graph on pp. 6-13 of its report). The total faculty has grown by more than 7%/yr since 1974--somewhat faster than total enrollments. The result has been a gradual increase in the faculty-to-student ratio over this period. That implies that an increasing amount of faculty effort has been devoted to activities other than teaching, and indeed there is evidence of that. The number of faculty devoted to research and extension activities grew at least 3 times faster than the amount devoted to instruction during the 1970s (Table 9-5). These observations provide the basis for a model of faculty demand to be discussed later.

The Association of American Medical Colleges, Washington, D.C. maintains the Faculty Roster, which is a record of degrees held by medical-school faculty. In 1970, there were 167 full-time veterinarians in a total faculty of 30,960. In 1980, there were 262 veterinarians in a total faculty of 53,941. These numbers are slightly lower than those generated and verified by the Committee (Table 9-2 and Appendix E), because not all schools reported their data in a timely manner and because the Committee included both faculty and staff with primary appointments (i.e., greater than 50%) in the medical school.

BUDGETED FUNDS

Over half the $255 million of expenditures budgeted in U.S. schools of veterinary medicine in FY 1981 came from state appropriations (Table 9-4). The second largest source of funds was grants and contracts, providing almost one-fourth of the budget. The remainder was provided by a variety of other sources, including clinics, tuition and fees, and extension services. These other sources as a group grew faster than any other source during the 1970s, averaging more than 12%/yr in terms of 1972 dollars. Grant and contract funds grew by more than 5%/yr in constant dollars from 1970 to 1981, whereas state appropriations grew by 4.9%/yr. It should be emphasized, however, that estimates of the total number of grant dollars available in relation to the numbers of teaching faculty members do not take into account the numbers or kinds of grants involved--i.e., several large grants to a few faculty members vs. many smaller grants to many persons.

For the 1980s, the Committee estimates that the change in constant dollars will be between +2%/yr and -2%/yr. The most likely projection is no growth (Figure 9-2).

DEMAND: FACULTY OF U.S. SCHOOLS OF VETERINARY MEDICINE

It seems clear from the foregoing discussion that faculty members in schools of veterinary medicine, like their counterparts in medical schools,[5,7,8] have become increasingly involved in activities other than teaching in recent years.[1,2,5-9] Research, clinics, and extension services now account for important segments of faculty activity. This indicates that the demand for faculty at schools of veterinary medicine is related to teaching, research, and service components. The teaching component can be readily represented by enrollments. The research component can be represented roughly by grant and contract funds, whose impact on faculty demand is assumed to operate with a delay of about a year. The service component is usually included in the duties expected of teaching and research faculty.

The academic demand model formulated here is based on the proposition that the faculty-to-student ratio would be relatively constant over time were it not for the additional faculty demand created by research and extension services (Figure 9-3). Thus, in the proposed model, the faculty-to-student ratio is a function of grant and contract funds lagged by a year--with the variables of the function determined empirically. Using the available data from the AAVMC for the period 1974-1981 (Figure 9-4), we find that a simple linear function is adequate to describe the relationship over this period (Figure 9-5).

To use the relationship to project faculty demand, it is necessary first to make some assumptions about the future behavior of the driving forces in the model, grant and contract funds and enrollments. The Committee expects enrollments to change at an annual rate between +1% and -1% through 1990, with zero growth as its best guess. Similarly, the Committee expects grant and contract funds in constant dollars to change at an annual rate between +2% and -2% through 1990, again with a best estimate of zero growth.

Putting the projections of grant and contract funds into the model produces estimates of the faculty-to-student ratios to be expected in 1990, and applying the projected enrollments produces the estimated faculty size in 1990. In addition to demand created by growth of faculty, vacancies are also created by attrition. In this case, we have no precise data on attrition rates in schools of veterinary medicine, but we do have data on bioscientists in other fields,[5-7] and we have used those rates (1%/yr due to death and retirement and 3%/yr due to other causes) in this model. The resulting total demand for faculty is shown in Table 9-6.

Under the most optimistic circumstances foreseen by the Committee--2%/yr growth in grant and contract funds and 1%/yr growth in enrollments--faculty is projected to expand at about 1.6%/yr, generating on the average about 200 vacancies per year during the period 1981-1990.

In the worst-case projection, i.e., if grant and contract funds decrease by 2%/yr and enrollments decrease by 1%/yr, faculty would contract by about 1.9%/yr or about 60 positions per year, but attrition would create about 120 vacancies per year, for a net demand of about 60 positions per year.

There is most likely to be no growth in either enrollments or grant and contract funds, in which case there would be essentially no expansion of faculty, but attrition would create about 120 vacancies per year.

So far, the projections have concentrated on veterinary medical school faculty without regard to type of degree. In this discussion, we are concerned primarily with persons holding veterinary degrees, and we would like to be able to make demand projections specific to these scientists. Unfortunately, this is difficult to do with the available data, which provide only an estimate of the faculty holding veterinary degrees in 1981. About the best that can be done is to apply this percentage (78%) to the projections of demand for total faculty to obtain estimates of the demand for veterinarians in veterinary medical schools of between 50 and 160 per year through 1990, with a most likely estimate of about 90 veterinarians per year.

This projection was developed both to show the projected need for veterinary specialists in this important occupational sector and to show how such projections can be derived when consistent data are available for a period of several years. Other occupational sectors are examined in Chapter 10.

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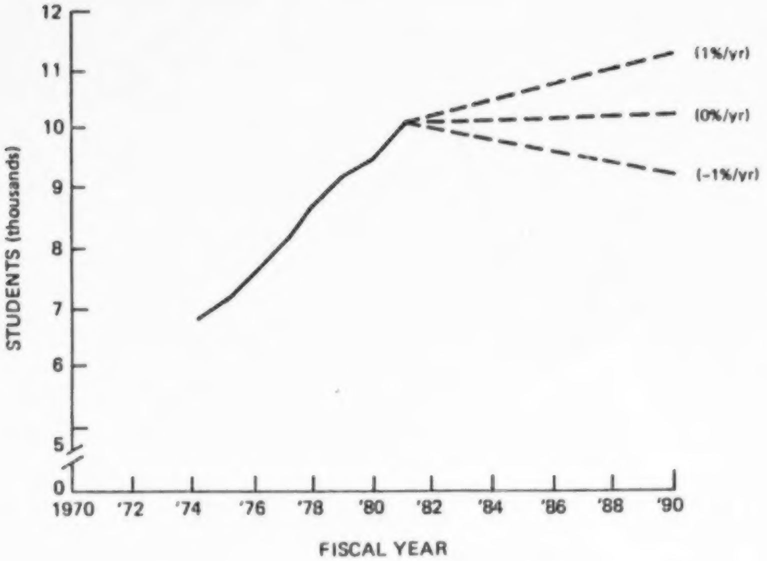

Figure 9-1. Veterinary medical students and graduate students (including interns and residents) enrolled in U.S. schools of veterinary medicine, 1974-1981, with projections to 1990. Data are from AAVMC. Projections are from Committee.

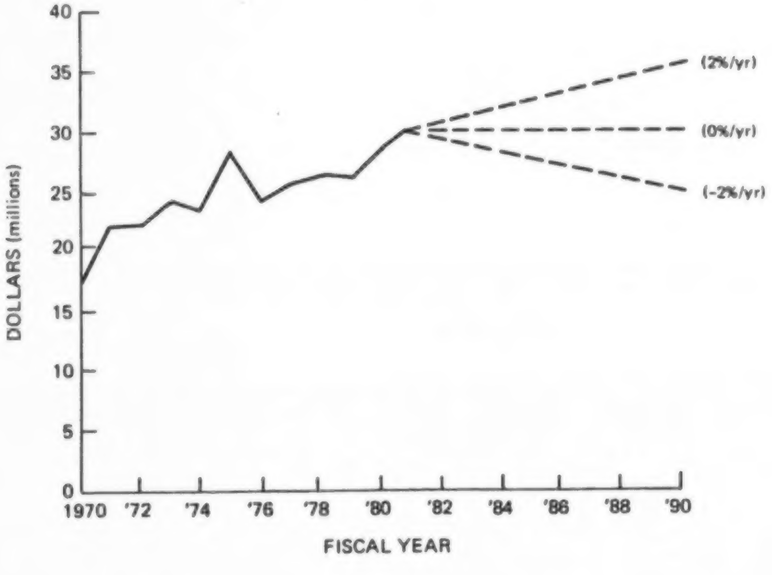

Figure 9-2. Funds budgeted for grants and contracts in U.S. schools of veterinary medicine, 1970-1981, with projections to 1990. Data are from AAVMC, adjusted to constant 1972 dollars with the GNP price deflator. Projections are from Committee.

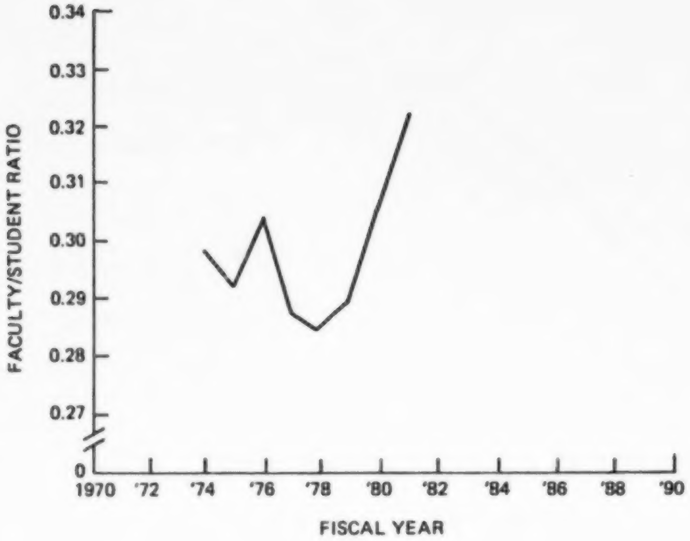

Figure 9-3. Faculty-to-student ratio in U.S. schools of veterinary medicine, 1974-1981. Faculty includes all professional and academic personnel, except interns and residents. Students include undergraduates, graduates, interns, and residents. Data are from AAVMC.

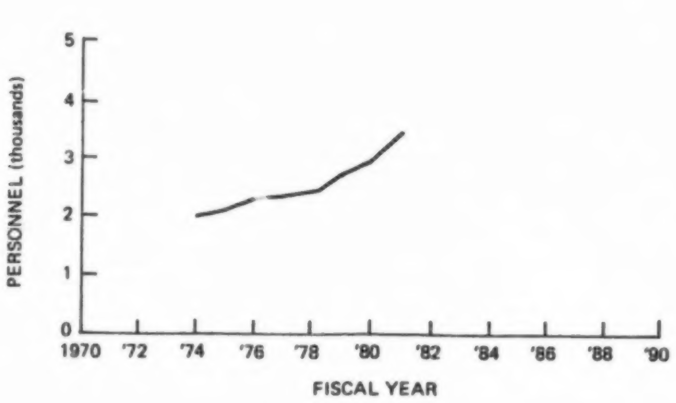

Figure 9-4. Total academic and professional personnel employed by U.S. schools of veterinary medicine, 1974-1981, excluding interns and residents. Data are from AAVMC.

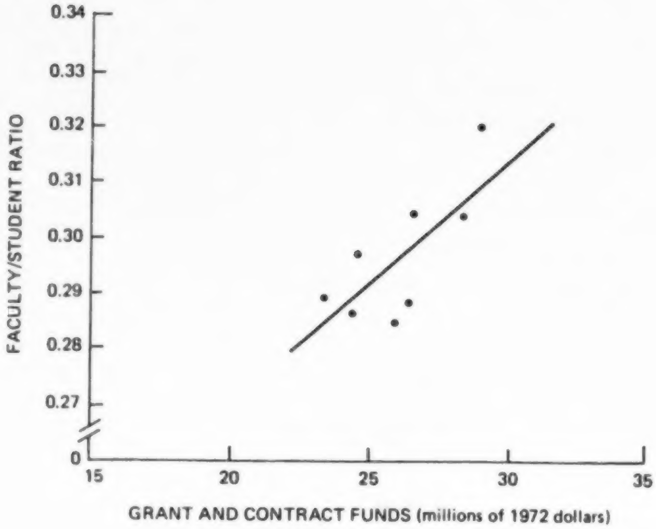

Figure 9-5. Relationship between faculty-to-student ratio in U.S. schools of veterinary medicine and funds for grants and contracts in prior year. Data are for 1974-1981. Solid line represents regression line fitted to data. Regression equation is: $(F/S)_t = 0.18192 + 0.00445(G_{t-1})$, where F = number of academic and professional personnel in U.S. schools of veterinary medicine; S= number of veterinary and graduate students, including interns and residents; and G = funds for grants and contracts in U.S. veterinary schools of medicine (millions of 1972 dollars). Data from AAVMC.

TABLE 9-1

Employment of Veterinarians Not in Private Practice in 1981[a]

Site of Employment	Number
Academic Institutions	
Agriculture, veterinary science	287
Dentistry	8
Medicine	406
Osteopathic medicine	2
Pharmacy	3
Public health	12
Veterinary medicine	2,567
Veterinary Technology (accredited)	52
Federal government agencies	
Department of Agriculture	
Food Safety and Inspection Service	1,314
Animal and Plant Health Inspection Service	654
Agricultural Research Service	78
Extension	80
Department of Health and Human Services	
Food and Drug Administration	74
National Institutes of Health	61
Alcohol, Drug Abuse, and Mental Health Administration	2
Communicable Disease Center	22
Environmental Protection Agency	13
Occupational Safety and Health Administration	1
Uniformed Services University of the Health Sciences	2
Department of State	2
Department of Defense	
U.S. Army	358
U.S. Air Force	216
U.S. Navy	3
Department of the Interior	7
Department of Commerce	4
National Aeronautics and Space Administration	3
Veterans' Administration	7
Smithsonian Institution (zoo)	5
State government agencies	
Animal disease control	475
Meat inspection	205
Public health	65
Industry	
Avian pathology	100
Other	1,200
Nonprofit institutions	
Humane societies	300
Primate centers	33
Zoos and aquariums	110
Private diagnostic laboratories	29
Total	8,760

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[a] Data sources described in Appendix D.

TABLE 9-2

Available Time-Series Data on Employment of Veterinarians Not in Private Practice at Selected Sites Since 1970[a]

Site of Employment	1970	1971	1972	1973	1974	Year 1975	1976	1977	1978	1979	1980	1981
Academic Institutions												
Medicine	-	-	346	-	376	386	396	404	410	438	449	406
Veterinary Medicine	-	-	-	-	1,574	1,647	1,837	1,864	1,965	2,105	2,257	2,567
Federal government agencies Total	3,426	3,407	3,371	3,334	3,254	3,140	-	-	-	2,981	-	2,908
Department of Agriculture	2,258	2,252	2,251	2,257	2,212	2,134	-	-	-	2,046	-	2,126
Department of State	-	-	4	6	3	3	-	-	-	-	1	2
Department of Health and Human Services Food and Drug Administration	62	55	75	75	75	74	-	-	-	74	75	74
National Institutes of Health	46	46	71	59	62	69	-	-	-	-	-	61
Environmental Protection Agency	-	16	28	17	19	19	-	-	-	14	22	13
Department of Defense	999	924	870	875	804	762	-	-	-	-	623	577
Department of Interior	-	-	5	5	5	5	-	-	-	-	-	7
National Aeronautics and Space Agency	-	-	5	5	5	3	-	-	-	-	-	3
Veterans' Administration	-	-	10	10	10	10	10	10	11	11	11	7
Smithsonian Institution (zoo)	-	-	4	4	4	4	-	-	-	-	-	5
Industry												
Avian Pathology	95	-	103	103	107	101	102	101	103	102	103	100
Nonprofit institutions												
Zoos and Aquariums	54	-	66	71	77	80	80	84	89	91	94	110

a Data sources described in Appendix D.

TABLE 9-3

Applicants, Enrollments, and Degrees in U.S. Schools of Veterinary Medicine, 1970-1981[a]

Enrollments

Fiscal Year	No. Schools Reporting	Vet. Undergraduate Students First Year	Vet. Undergraduate Students Total	Vet. Graduate Students Seeking: M.S.	Ph.D.	Cert. of Intern.	Cert. of Residency	Total	Other Graduate Students Seeking: M.S.	Ph.D.	Total	Projections: Vet. Students 1 yr	6 yr	Grad. Students 1 yr	6 yr	Veterinary Graduates
1970	18	1,341	4,875	312	312	18	13	655	202	278	480					1,071[b]
1971	18	1,430	5,006	262	302	36	7	607	252	252	504					1,022[b]
1972	18	1,453	5,149	269	276	41	18	604	304	326	630					1,039[b]
1973	18	1,580	5,439	252	224	53	34	563	343	311	654					1,050[b]
1974	18	1,594	5,727	222	202	43	48	515	233	207	440					1,159[b]
1975	19	1,669	6,005	248	189	44	57	538	350	223	573					1,341
1976	22	1,698	6,274	286	222	68	103	679	411	181	592	6,129	6,889	1,163	1,587	1,408
1977	22	1,855	6,571	319	246	60	168	793	487	260	747	5,294	6,449	1,253	1,676	1,531
1978	22	1,973	6,903	358	267	97	193	915	466	272	738	6,116	7,388	1,357	1,839	1,589
1979	23	2,086	7,317	364	255	97	249	965	471	291	762	6,075	7,177	1,585	1,972	1,637
1980	23	2,027	7,343	417	291	92	234	1,034	487	296	783	7,647	8,103	1,595	1,901	1,704
1981	25	2,237	8,191	343	282	96	194	915	522	265	787	7,767	8,327	1,480	1,801	1,845

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[a] Data from Association of American Veterinary Medical Colleges.[2]

[b] Number of fourth-year students.

TABLE 9-4

Budgeted Funds in U.S. Schools of Veterinary Medicine, 1970-1981 (millions of dollars)[a]

	State Appropriations					Other Sources										
Fiscal Year	Teach. Hosp. & Clinics	Diag-nostic Labs.	Other	Total	Grants and Contracts	Teach. Hosp. & Clinics	Diag-nostic Labs.	Cont-inuing Educ.	Gifts & Endow-ments	Tuition Fees	Sales	Other	Total	Agric. Exper. Station	Grand Total	GNP Price Deflator (1972=100)
1970	1.451	0.871	34.686	37.008	15.601	3.252	0.404	0.256	0.993	0.230	0.481	1.712	7.328	3.416	63.353	91.4
1971	1.122	1.295	36.633	39.050	21.282	4.532	0.155	0.385	1.264	0.971	0.371	2.813	10.491	3.239	74.062	96.0
1972	1.479	1.960	35.128	38.567	22.496	4.382	0.349	0.372	1.119	1.152	0.524	1.013	8.911	2.311	72.285	100.0
1973	1.734	1.574	40.323	43.631	25.847	5.073	0.365	0.901	1.706	1.579	0.475	4.598	14.697	3.113	87.288	105.8
1974	2.611	-	44.541	47.152	26.840	5.013	-	-	2.508	2.326	1.242	2.713	13.802	-	87.794	116.0
1975	-	-	-	49.978	35.960	8.608	1.390	-	2.162	2.447	0.891	6.137	21.635	-	107.573	127.2
1976	-	-	-	57.534	32.517	8.886	1.524	-	2.017	3.020	1.960	6.045	23.452	-	113.503	133.9
1977	-	-	-	69.836	36.533	11.157	1.089	-	2.682	3.543	1.323	8.787	28.581	-	134.950	141.3
1978	13.574	4.945	63.614	82.133	40.035	12.413	1.131	0.280	2.812	4.654	1.405	9.365	32.060	6.986	161.214	152.05
1979	17.177	5.080	74.964	97.221	43.753	14.422	1.551	0.346	2.835	4.531	0.813	9.108	33.606	9.091	183.671	165.46
1980	16.865	5.599	89.490	111.954	51.094	16.736	1.651	0.412	3.159	5.647	0.795	12.318	40.718	11.165	214.931	177.36
1981	18.736	6.405	107.575	132.716	57.857	21.009	2.440	0.503	5.271	9.360	0.615	15.087	54.285	10.749	255.607	193.58

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[a] Data from Association of American Veterinary Medical Colleges.[2]

TABLE 9-5

Faculty and Other Professional Personnel Employed by U.S. Schools of Veterinary Medicine, 1970-1981[a]

	No. Full-Time Equivalent Faculty, by Activity and Source of Funds										No. Academic and Professional Personnel, by Rank								
	Paid with State Funds			Paid with Other Income			Total												
Fiscal Year	Instruction	Research	Extension	Instruction	Research	Extension	Instruction	Research	Extension	Grand Total	Administrator	Professor	Associate Professor	Assistant Professor	Instructor	Lecturer and Associate	Intern and Resident	Other	Total
1970	1,324.2[b]	80.9[c]	76.6	167.9[b]	233.2[c]	NA	1,492.1[b]	314.2[c]	76.6	1,882.8	NA	NA	NA	NA	NA	NA	NA	NA	
1971	1,364.2[b]	79.6[c]	72.4	203.2[b]	192.8[c]	NA	1,567.4[b]	272.4[c]	72.4	1,912.2	NA	NA	NA	NA	NA	NA	NA	NA	
1972	1,325.2[b]	80.3[c]	75.2	165.6[b]	238.1[c]	NA	1,490.9[b]	318.4[c]	75.2	1,884.4	NA	NA	NA	NA	NA	NA	NA	NA	
1973	1,380.9[b]	79.4[c]	66.3	209.0[b]	269.6[b]	NA	1,589.9	349.0	66.3	2,005.2	NA	NA	NA	NA	NA	NA	NA	NA	
1974	1,192.0[b]	185.5[c]	55.3	166.3[b]	251.5[b]	19.4	1,358.2	437.0	74.7	1,869.9	NA	549	417	385	173	358	146	156	2,184
1975	1,332.6[b]	164.1[c]	73.4	284.9[b]	285.1[b]	26.9	1,617.5	449.2	100.3	2,167.1	NA	569	471	419	160	434	199	70	2,322
1976	1,371.9	208.9	85.8	340.5	326.2	41.3	1,712.4	535.1	127.1	2,374.6	70	592	481	427	178	546	228	73	2,595
1977	1,482.9	214.1	123.4	312.8	305.2	38.4	1,795.7	519.3	161.8	2,476.9	101	591	505	441	165	563	253	56	2,655
1978	1,564.0	251.6	128.7	270.2	276.0	52.4	1,834.2	527.7	181.1	2,542.9	93	647	540	517	126	571	313	38	2,845
1979	1,650.7	280.7	136.4	254.4	288.4	72.6	1,905.0	569.1	209.0	2,683.2	106	678	522	556	145	651	358	55	3,071
1980	1,766.2	280.8	170.8	280.9	322.9	50.4	2,047.0	603.8	221.2	2,872.1	124	703	532	628	160	741	387	21	3,296
1981	1,830.9	328.9	205.9	284.7	381.1	45.1	2,115.5	709.9	250.9	3,076.4	116	844	609	691	188	862	398	0	3,706

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[a] Data from Association of American Veterinary Medical Colleges.[2] NA=not available.

[b] Teaching and research combined.

[c] Research only.

TABLE 9-6

Projected Growth in U.S. Veterinary Medical School Faculty, 1981-1990, Based on Projections of Enrollment and Funds for Grants and Contracts[a]

Assumptions about Veterinary Students plus Graduate Students		Assumptions about Funds Budgeted for Grants and Contracts in U.S. Schools of Veterinary Medicine, millions of 1972 dollars		
		I	II	III
		Will expand at about 2%/yr to $36 million in 1990	Will remain at 1981 level of $30 million through 1990	Will decrease by 2%/yr to $25 million in 1990
A. Will grow at 1%/yr, reaching 11,250 students by 1990	Expected size of faculty in veterinary schools (F) in 1990	3,800	3,540	3,320
	Annual growth rate in F from 1981 to 1990	1.6%	0.8%	0%
	Average annual increment due to faculty expansion	50	30	0
	Annual replacement needs due to:[b] death and retirement	40	30	30
	other attrition	110	100	100
	Number of positions expected to become available annually on veterinary school faculties	200	160	130
B. Will remain at 1981 level, 10,291, through 1990	Expected size of faculty in veterinary schools (F) in 1990	3,480	3,240	3,040
	Annual growth rate in F from 1981 to 1990	0.6%	-0.2%	-0.9%
	Average annual increment due to faculty expansion	20	-10	-30
	Annual replacement needs due to:[b] death and retirement	30	30	30
	other attrition	100	100	100
	Number of positions expected to become available annually on veterinary school faculties	150	120	100
C. Will decrease by 1%/yr, reaching 9,400 students by 1990	Expected size of faculty in veterinary schools (F) in 1990	3,180	2,960	2,770
	Annual growth rate in F from 1981 to 1990	-0.4%	-1.2%	-1.9%
	Average annual increment due to faculty expansion	-10	-40	-60
	Annual replacement needs due to:[b] death and retirement	30	30	30
	other attrition	100	90	90
	Number of positions expected to become available annually on veterinary school faculties	120	80	60

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[a] Faculty defined as all academic and professional personnel employed by U.S. schools of veterinary medicine, regardless of rank or tenure status, except interns and residents (counted as students). Projections computed from the model $(F/S)_t = 0.182 + 0.00445(G_{t-1})$ where F = academic and professional personnel employed in U.S. schools of veterinary medicine, excluding interns and residents; S = undergraduate and graduate students in U.S. schools of veterinary medicine, including interns and residents; and G = funds budgeted for grants and contracts in U.S. schools of veterinary medicine, lagged by 1 yr. Data are for 1974-1981 and are from AAVMC.

[b] An attrition rate due to death and retirement of 1%/yr and an attrition rate due to other factors of 3%/yr are assumed.

10

DEMAND FOR VETERINARY SPECIALISTS

The current and future needs for veterinarians have to be reassessed regularly to meet the demand. For instance, the effective control or eradication of such livestock diseases as tuberculosis and hog cholera usually results in a shift in emphasis for veterinarians to the control of other diseases. The unique training of veterinarians, which combines the basic and clinical sciences as applied to many species, also permits use of their talents in new directions, such as basic scientific research, topical issues of animal health and welfare, environmental toxicology, and applied technology and development in the many facets of agriculture. The demand for veterinary services should also be adjusted to account for the current trend toward reduced numbers of laboratory animals used in biomedical research,[1] which is accompanied by an increased emphasis on in vitro techniques (e.g., tissue culture) and mathematical modeling. However, this may be balanced by the increase in the chronicity of animal use, leading to increases in the numbers of resident animals requiring veterinary care and study in many research institutions.[2]

The Committee assumed that legislative and regulatory developments would have an indirect impact on academic institutions, through increases or decreases in the need for training of veterinary specialists with potential for employment primarily in regulatory agencies or industrial and contract research laboratories. An additional minor impact was expected in the form of consultation services rendered by academic veterinary specialists in response to needs engendered by legislative or regulatory developments.

There appear to be no complete data with which to assess the past, present, or future impact of legislative or regulatory developments on veterinary specialists in academia, but the model developed in Chapter 9 provides a reasonable measure of the overall effect. The availability of funds for grants and contracts coupled with the faculty-to-student ratio should be expected to reflect the ability of the academic institutions to respond to the needs for veterinary specialists. A great deal of information on veterinary manpower was made available to the Committee, including some limited survey information. However, a properly designed and conducted survey could generate the data needed. A projected survey outline is shown in Appendix F, which is included as a starting point to be modified as needed when the survey is conducted.

FACULTY NEEDS IN PATHOLOGY, TOXICOLOGY, AND PHARMACOLOGY

A survey of medical and veterinary school faculty needs in toxicology, pathology, and pharmacology was conducted independently, and the information was made available to the Committee (W. C. Bowie, R. R. Dalvi, and G. E. Heath, School of Veterinary Medicine, Tuskegee Institute, personal communication, 1982). The survey included 25 schools of veterinary medicine and 118 schools of medicine in the United States. A survey form was mailed to the pharmacology-toxicology and pathology department chairmen in each medical and veterinary medical school; the percentage responses are shown in Table 10-1. Each was asked to provide the following information:

- Number of faculty positions in each discipline during fiscal 1982 and projections for fiscal 1983.
- Number of graduate students in each discipline.
- Number of graduate students with veterinary degrees.
- Number of postdoctoral fellows with veterinary and Ph.D. degrees.
- Number of postdoctoral fellows with Ph.D. degrees.

Tables 10-2 through 10-6 summarize manpower statistics for the training of personnel in pharmacology-toxicology, pathology, and comparative pathology. Table 10-2 compares the current and projected numbers of faculty positions for each of these disciplines in medical and veterinary medical schools. Although there is a projected 2.5% decrease in the number of pharmacologist-toxicologist positions in medical schools, veterinary schools predict a 3.4% increase in positions for fiscal 1982. The 1977 study of Davis,[2] however, indicated 124 pharmacologist-toxicologist positions in veterinary schools--considerably more than the current number. For pathologists and comparative pathologists, 4.0% and 3.2% increases, respectively, were predicted for medical schools, whereas 1.4% and 8.8% decreases were predicted for veterinary schools. Overall, the three specialties had projected annual changes of +1.1% and -1.3% in schools of medicine and veterinary medicine, respectively.

Overall veterinary graduate student training appeared to be decreasing substantially in schools of medicine (-18.3%) and increasing slightly in veterinary schools (Table 10-3). Of the three specialties surveyed, only comparative pathology, which focuses on comparisons between animal and human diseases, showed a projected overall increase, of 10.6% (+21.7% for medical schools and +4.7% for veterinary schools). However, the total number of positions for graduate students of all backgrounds training in the abovementioned disciplines had projected overall increases of 4.4% in schools of medicine and 2.6% in schools of veterinary medicine from fiscal 1982 to fiscal 1983 (Table 10-4).

There was an overall increase of 6.8% in the projected number of positions for postdoctoral fellows with the Ph.D. degree in the three disciplines in schools of medicine and a 16.7% increase in schools of veterinary medicine, although the projected number of veterinary positions was only 14 (Table 10-5). The number of positions for postdoctoral fellows with veterinary and Ph.D. degrees in medical schools showed an overall projected decrease of 3.5% for the three specialties but a 25% increase in schools of veterinary medicine (Table 10-6). The total number of persons in this group is small, but it is important with respect to projected needs for veterinarians in these specialties, because the total number of specialists in these fields is still relatively small. The recent report, Personnel Needs and Training for Biomedical and Behavioral Research,[3] recommended maintaining current levels of support for predoctoral and postdoctoral fellows in the basic biomedical sciences. It recommended an increase in support for traineeships and fellowships for postdoctoral training in the clinical sciences, "to encourage physicians and *other health professionals* [italics added] to undertake research training in preparation for research careers." It is hoped that this federal support will be provided in accordance with the recommendations to provide veterinarians and others with support for additional specialty training in the disciplines of greatest demand.

U.S. GOVERNMENT AGENCIES

Present and projected trends in U.S. government agencies can be evaluated on the basis of data collected in the 1978 A. D. Little report.[4] Another data source that was helpful in the evaluation of past and present trends in the number of veterinarians employed by the U.S. government was *The Federal Veterinarian*, which gave rise to the data shown in Table 9-2. These data show an overall decrease of 15.1% in the number of veterinarians collectively employed by all federal agencies from 1970 to 1981. They do not take into consideration, however, the extensive part-time manpower contributions of veterinarians who serve in various capacities as consultants to the U.S. government (e.g., grant and contract reviews, committee assignments, other paid consultantships). Unfortunately, there is at present no mechanism to gather data on the nature or extent of this important use of veterinary specialist manpower.

DEPARTMENT OF AGRICULTURE

Use of the data sources cited above for the USDA shows a stable number of veterinarians employed (about 2,250) from 1970-1973; this decreased to about 2,100 by 1975 and has remained there ever since. Thus, additional demands created by legislation and regulations have had no effect on the overall supply of veterinarians hired by the USDA.

Despite the stable veterinary employment for the USDA (Tables 9-1 and 9-2), the response to our questionnaire from APHIS indicated a projected need for additional veterinary specialists trained in laboratory-animal medicine, immunology, and pathotoxicology, because of the demand for more rigidly controlled animal testing, greater use of vaccines, and increased emphasis on toxicant-induced diseases. Recently proposed efforts in support of legislation concerning the welfare of animals used in research and testing,[5] however, should further compound the existing shortage of manpower in this effort. Additional demands may also be generated in USDA due to retirements. Since the average age of veterinarians in USDA is over 52, this group will be affected substantially if early retirements are encouraged.

On an even more pessimistic note, the 1980 USDA-SEA report[6] identified salary discrepancies between federal and industrial employers as a significant disadvantage in federal hiring of board-certified veterinary pathologists at the GS-11 or GS-12 entry level. The report recommended several approaches to overcome this problem, including aggressive advertisement of federal job openings for veterinarians with concerted efforts to achieve the highest allowable salary, seeking retired military veterinarians because of the incentive of the associated federal fringe benefits, seeking to change federal personnel standards for identifying veterinary specialists to permit "direct hire authority," offering a sabbatical program to attract other federal personnel as well as academic faculty, obtaining a recruitment-retirement bonus system similar to that provided to federally hired physicians, and expansion of existing postprofessional education and training with the requirement that employees remain for a payback period equal to the length of training.

The recruitment of veterinarians with a Ph.D. into the Agricultural Research Service of USDA is extremely difficult. For example, the starting grade for a D.V.M.-Ph.D. veterinary pathologist is a GS-11 (starting salary, $23,566 in early 1982), with or without board certification. The salary is not competitive with academic or industrial salaries and precludes hiring highly qualified candidates. "Direct hire" is not possible; the procedure requires evaluation by nonscientists and takes 4-12 months for final approval.

DEPARTMENT OF DEFENSE

A dramatic change has occurred in the numbers of veterinarians employed by the Department of Defense (Table 9-2). During the period 1970-1981, there has been a reduction in veterinary manpower from 999 to 577, in part as a result of the phasing out of the U.S. Air Force Veterinary Corps. It is anticipated that this trend will continue.

In response to the Committee's questionnaire, the DOD showed in-ceiling needs for 1985 and 1990 to be almost identical with current staffing. Desired numbers, however, differed substantially and showed an increase of 23 veterinarians by 1985 above the current 279, with a total increase of 61 by 1990. Only food technology projected a decrease of 5 positions. The breakdown of the additional desired positions for 1990 by specialty was as follows: laboratory-animal medicine, 15; veterinary pathology, 16; toxicology, 10; physiology, 12; surgery, 4; environmental science, 3; microbiology, 3; radiobiology, 1; and psychology, 2. The field of food technology was expected to decrease by 5.

The DOD's Maximus, Inc., report[7] with respect to the Army Veterinary Corps summarized current manpower needs, which have been substantially reduced because the original function of animal care has largely disappeared. Some animals are still maintained, and staffing for this function alone would require up to 75 veterinarians. Other duties that involve veterinarians include food inspection, zoonosis monitoring and control, public health and sanitation, and preventive medicine. The report recommended that the size of the Veterinary Corps be reduced by at least 10%; that the Corps be made multidisciplinary to provide other specialists for functions where veterinarians are not needed; that the veterinary scholarship program, which is expensive, be phased out; and that veterinary special pay, which is unwarranted for routine functions, be terminated.

DEPARTMENT OF THE INTERIOR

Manpower needs and turnover are both very low in this agency (one or two persons every 2 yr), according to the response to our questionnaire. Wildlife disease is the only specialty in need of expansion, and the Animal Welfare Act is the only legislation with an impact on overall needs for veterinary specialists.

FOOD AND DRUG ADMINISTRATION

There was an increase from 45 authorized slots[4] to 75 veterinarians employed by the FDA (Table 9-2) from 1967 to 1972, and the number has since remained essentially constant. In the late 1970s, the FDA anticipated an increase in the number of veterinarians employed, to 160 by 1990.[4] The response to our questionnaire indicated a more realistic 95 desired by 1990, with major increases requested in the specialties of pathology (22), pharmacology (9), physiology (7), and toxicology (7). It was anticipated in early 1981 that the need for specialty-trained veterinarians would increase, owing to pressure to improve environmental factors that have an impact on public health; introduction of new technology, including genetic engineering, immunopharmacology, and antiviral chemotherapy; and expected expansion of current services because of growth of federal programs, such as required for compliance with the Good Laboratory Practice Regulations. The data in Table 9-2 for the past decade and the recently conservative fiscal climate may, however, limit implementation of most of these recommendations.

ENVIRONMENTAL PROTECTION AGENCY

The EPA is another regulatory agency likely to be affected by recent legislative and regulatory developments. This agency was created in the early 1970s to centralize the regulation of a number of environmentally related functions, including the regulation of substances under the statutory framework of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended. Other key regulatory duties of EPA are derived from the Toxic Substances Control Act of 1976 (TOSCA), the Clean Air Act (1970), the Safe Drinking Water Act (1974), and the Resource Conservation Recovery Act (1976). The EPA is currently considering implementation of its own good laboratory practices requirements.

The number of veterinarians in EPA (Table 9-2) is too small to assess future EPA needs for such specialists. The A. D. Little report[4] did not list data on EPA separately, but included them in a category entitled "Other Agencies." This category also included data on Aid to International Development (AID), Consumer Product Safety Commission (CPSC), and Department of Transportation (DOT). The EPA Office of Pesticide Programs provided a report prepared by ICF, Inc.,[8] that addressed current trends in the market for chemical-safety testing services. With respect to needs for veterinarians with specialty training, there was a marked shortage of veterinary pathologists and a smaller shortage of toxicologists, because of the demand for high-quality animal testing.

NATIONAL CANCER INSTITUTE, NATIONAL INSTITUTES OF HEALTH

In 1979, NCI noted a shortage of manpower needed for the carcinogenesis testing program.[9] Difficulties in staffing the program included the absence of research, the uncertainty of the future of the program, the scarcity of desired specialists in toxicology and veterinary pathology, and the inadequacy of federal pay scales for such specialists. The NCI later implemented a training program to support up to seven postdoctoral trainees annually which provided a total of 11 trainees in pathology over the 5-yr term of the project.

PRIVATE INDUSTRIAL AND CONTRACT RESEARCH LABORATORIES

In addition to the regulatory agencies discussed above, the industrial and contract laboratories performing animal studies of drug and chemical toxicity constitute a well-defined entity useful in evaluating the impact of legislative and regulatory developments on employment trends for veterinary specialists. In the context of the present state of the art, the veterinary specialists involved primarily in this kind of research are pathologists, toxicologists, and those trained in laboratory-animal medicine. The 1980 biennial survey of the American Association of Industrial Veterinarians[10] indicated 370 respondents involved primarily in management, technical services, research, toxicology, and laboratory-animal medicine.

Compared with other veterinary fields, there is generally less information available on industrial veterinarians from which to assess the impact of recent legislative and regulatory developments on trends in employment of veterinary specialists in industrial and contract research laboratories. To generate data for a preliminary evaluation, the Committee contacted veterinary specialists in 12 research laboratories. These were selected to reflect a cross-section of chemical, pharmaceutical, and contract research laboratories most likely to be affected by recent legislative and regulatory developments. The results of these contacts are presented in Table 10-7. Table 10-8 is a summation of past and projected trends for 1978-1981 and 1981-1984, respectively. These data indicate that there was an 8-14%/yr growth rate for pathology and laboratory-animal medicine for 1978-1981. For the same interval, although the sample was small, there was a slight decrease in veterinarians employed as toxicologists--an annual net change of -7%.

For the interval of 1981-1984, the veterinary specialists at the 12 industrial and contract research laboratories projected an annual increase of 4-7% for each of the 3 veterinary specialty groups.

Data for 1978 from the 1980 Institute of Laboratory Animal Resources survey[2] led to projected annual increases of about 7% for laboratory-animal medicine and 10% for pathology for the years 1978 to 1983 (Table 10-9). These findings are in general agreement with the current limited survey. Needs for all biomedical scientists in the commercial sector were shown to be increasing by more than 10%/yr during 1977-1979, with a prediction of 1,000 new positions per year in the commercial sector for all basic biomedical scientists.[3] The current figure for industrial veterinarians is conservatively estimated at 1,200, and this group may show the largest relative increase through 1990.

In September 1981, Margaret Goodman of the General Accounting Office undertook a telephone survey of agriculture personnel needs. She spoke with the vice presidents for research of 20 Fortune "500" companies and found that there was a manpower shortage in veterinary pathology, but that many companies would prefer to hire persons with a 2-yr associate's degree in veterinary technology and train them on the job.

FUTURE DEMAND FOR VETERINARY SPECIALISTS

Experts in various veterinary disciplines were also surveyed by *DVM Newsmagazine*[11] regarding trends in career opportunities for the coming decade. Veterinary specialists were needed in food-animal, herd, and avian medicine; those needs will increase as food costs increase and the widespread use of antibiotics decreases. The pharmaceutical industry has openings for veterinarians with advanced training in pathology, pharmacology, toxicology, and microbiology. Medical, dental, and pharmaceutical schools are hiring veterinarians as faculty members with emphasis on the use of animal models in comparative medicine. Veterinarians will be needed in aquaculture as fish farming increases. And veterinarians with biomedical expertise pertaining to exotic fish and birds will be needed in greater numbers as these species become more popular as pets. Anticipated future roles for veterinary specialists are discussed more fully in the report by Booth and colleagues, excerpted in Appendix A.

The output of veterinary schools has been tabulated annually by the AAVMC[12] since 1970. The Bureau of Health Professions of HRA[13] and A. D. Little, Inc.,[4] estimated the number of veterinarians in 1990 to be in the range of 48,200-53,000. The number of veterinarians predicted by the Terry report[14] to be needed in 1990 was 49,484. This shows a rough correlation between the projected supply of and the demand for veterinarians in 1990. Recently proposed reductions in various forms of student aid, however, could cause a downward revision of the total number of veterinarians expected to be available in 1990.

As has been shown in Chapter 6, a variety of veterinary functions can be performed by other health professionals and paraprofessionals, particularly public health, biomedical research, and medical education. Thus, the supply of other health professionals[3] and paraprofessionals affects the needs for veterinary manpower in some specialties. Because an oversupply of physicians is predicted in the 1990s,[13] some of these functions could be met by physicians with specialty training. The total number of animal technician graduates from AVMA-accredited U.S. animal technology programs is currently 9,207 and the number of graduates for 1981 is 997.[15] These numbers have been steadily increasing, and the increase provides a pool of trained paraprofessionals to perform veterinary functions.

As indicators of demand, the Committee found an increasing supply of veterinary manpower in pathology, toxicology, laboratory-animal medicine, pharmacology, immunobiology, physiology, and epidemiology, with an increase in specialty board memberships of 550 from 1976 to 1981 (Table 10-10). Despite these increases in the number of board-certified specialists being trained, the total number for the entire profession is very small (about 2,000 for 1982).

The question also remains whether the supply will keep pace with the demand in the next decade. Current and projected needs for veterinarians in these specialties have been estimated on the basis of interviews with industrial, academic, and government representatives, examination of classified advertisements (Table 10-11), and citations of disciplines needed as a result of legislation and regulations. Table 10-12 lists these demand indicators in relation to fields of specialization. The fields in which all three categories apply are clinical medicine, epidemiology, laboratory animal medicine, microbiology, pathology, and toxicology. These fields are predicted to have the greatest demand for veterinary specialists, and are strongly recommended for postdoctoral, Ph.D., and other training.

Another way to estimate the demand for veterinary specialists is to divide needs by type: those needs which require veterinarians as opposed to other health professionals (e.g., laboratory-animal medicine), and those in which a veterinary degree is nonessential and veterinarians are competing for jobs with other professionals (e.g., toxicology, molecular biology, and immunology).

Finally, consultants, agency officials, and others predict shortages in veterinary and other biomedical personnel. In testimony before the NRC Committee on a Study of National Needs for Biomedical and Behavioral Research Personnel, on the occasion of publication of its 1981 report,[3] the following statement was made: "What appears ... to be a rapidly growing shortfall in the production of certain types of basic biomedical scientists, in particular those in demand as a result of the new 'biotechnology' has been, in part, missed by the 1981 report." The speaker, representing the American Society for Microbiology, went on to assert that the commercial market for biomedical scientists had expanded more rapidly than the 10% increase described and that biotechnology firms were showing technical staff increases of almost 1,000 per year in this industry alone, whereas the report estimated growth of the entire commercial sector to be 1,000 per year for all basic biomedical scientists. This growth indicates a potential for growth which may provide a demand for suitably trained veterinary specialists.

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TABLE 10-1

Response Rate, by Discipline, to Veterinary Specialty Manpower Questionnaire of December 4, 1981[a]

Respondents	Response, %
Pharmacology-toxicology:	
Medicine	60
Veterinary medicine	76
Pathology:	
Medicine	44
Veterinary medicine	92

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[a] Bowie *et al.*, personal communication, 1982.

TABLE 10-2

Faculty Positions Budgeted and Projected for Pharmacology-Toxicology, Pathology, and Comparative Pathology in Medical and Veterinary Medical Schools[a]

Discipline	No. Budgeted for FY 1982	No. Projected for FY 1983	Projected Change, %
Pharmacology-toxicology:			
Medicine	847	826	- 2.5
Veterinary medicine	88	91	+ 3.4
Pathology:			
Medicine	1,002	1,042	+ 4.0
Veterinary medicine	179	176	- 1.7
Comparative pathology:			
Medicine	31	32	+ 3.2
Veterinary medicine	45	41	- 8.9
Totals:			
Medicine	1,880	1,900	+ 1.1
Veterinary medicine	312	308	- 1.3

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[a] Bowie *et al.*, personal communication, 1982.

TABLE 10-3

Current and Projected Veterinary Postgraduate Students in Pharmacology-Toxicology, Pathology, and Comparative Pathology in Medical and Veterinary Medical Schools[a]

Discipline	No. for FY 1982	No. Projected for FY 1983	Projected Change, %
Pharmacology-toxicology:			
Medicine	38	36	- 5.3
Veterinary medicine	40	39	- 2.5
Pathology:			
Medicine	108	74	-31.5
Veterinary medicine	128	131	+ 2.3
Comparative pathology:			
Medicine	23	28	+21.7
Veterinary medicine	43	45	+ 4.7
Totals:			
Medicine	169	138	-18.3
Veterinary medicine	211	215	+ 1.9

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[a] Bowie *et al.*, personal communication, 1982.

TABLE 10-4

Current and Projected Graduate Students of All Backgrounds in Pharmacology-Toxicology, Pathology, and Comparative Pathology in Medical and Veterinary Medical Schools[a]

Discipline	No. for FY 1982	No. Projected for FY 1983	Projected Change, %
Pharmacology-toxicology:			
Medicine	941	976	+ 3.7
Veterinary medicine	104	104	0.0
Pathology:			
Medicine	270	283	+ 4.8
Veterinary medicine	144	150	+ 4.2
Comparative pathology:			
Medicine	23	29	+26.1
Veterinary medicine	55	57	+ 3.6
Totals:			
Medicine	1,234	1,288	+ 4.4
Veterinary medicine	303	311	+ 2.6

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[a] Bowie *et al.*, personal communication, 1982.

TABLE 10-5

Current and Projected Postdoctoral Fellows with Ph.D.s in Pharmacology-Toxicology, Pathology, and Comparative Pathology in Medical and Veterinary Medical Schools[a]

Discipline	No. for FY 1982	No. Projected for FY 1983	Projected Change, %
Pharmacology-toxicology:			
Medicine	309	335	+ 8.4
Veterinary medicine	9	11	+22.2
Pathology:			
Medicine	115	115	0.0
Veterinary medicine	2	2	0.0
Comparative pathology:			
Medicine	4	7	+75.0
Veterinary medicine	1	1	0.0
Totals:			
Medicine	428	457	+ 6.8
Veterinary medicine	12	14	+16.7

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[a] Bowie *et al.*, personal communication, 1982.

TABLE 10-6

Current and Projected Postdoctoral Fellows with Veterinary and Ph.D. Degrees in Pharmacology-Toxicology, Pathology, and Comparative Pathology in Medical and Veterinary Medical Schools[a]

Discipline	No. for FY 1982	No. Projected for FY 1983	Projected Change, %
Pharmacology-toxicology:			
Medicine	70	72	+ 2.9
Veterinary medicine	8	9	+12.5
Pathology:			
Medicine	36	27	-25.0
Veterinary medicine	13	16	+23.1
Comparative pathology:			
Medicine	8	11	+37.5
Veterinary medicine	3	5	+66.7
Totals:			
Medicine	114	110	- 3.5
Veterinary medicine	24	30	+25.0

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[a] Bowie *et al*., personal communication, 1982.

TABLE 10-7

Data Obtained from Industrial Laboratories Employing Veterinarians with Postgraduate Training

Type of Laboratory	State	Slots Filled by Vets. with Advanced Training[a]		Projected Additional Slots Created by Legislation, New Work, Etc., 1984[a]	Comments of Contact Scientist
		1978	1981		
Chemical	MI	P 4 L 1 T 3	P 6 L 1 T 2	P +1 L 0 T 0	Some slight expansion of laboratory activity
Chemical-pharmaceutical	IN	A 1 P 8 L 0 T 0	A 1 C 1 P 13 L 1 T 0	P +4 C +1 L +1 T 0	Active laboratory expansion in ecotoxicology
Contract	AR	P 8	P 4 L 1	P +1 L 0	Future uncertain
	MA	P 2 L 0 T 3	P 1 L 1 T 1	P 0 L +1 T 0	Laboratory activity at plateau; more use of occasional consultants
	MD	P 1 L 1 T 0	P 3 L 2 T 0	P 0 L 0 T 0	Present activity at plateau; future dependent on bioassay needs
	VA	A 1 P 7 L 3 T 1	A 1 P 10 L 3 T 1	A 0 P +2 L +1 T 0	Present substantial decrease in workload; reentering active bioassay role
Contract-chemical	NC	P 2 L 0 T 1	P 3 L 0 T 1	P +1 L 0 T +1	Some slight expansion of laboratory activity
Pharmaceutical	MI	P 12 L 3 T 0 M 1	P 13 L 4 T 1 M 1	P +1 L 0 T 0 M 0	Laboratory activity at plateau; expansion likely to be nonveterinary toxicologists
	NC	P 5 L 5 T 0	P 5 L 5 T 0	P +1 L 0 T 0	Laboratory activity at plateau
	NJ	P 3 L 0 T 0	P 4 L 1 T 0	P 0 L 0 T 0	Laboratory activity has peaked
	NJ	P 0 L 0 T 1 CDTS 9	P 1 L 0 T 1 CDTS 9	P 0 L 0 T 0 CDTS 0	Laboratory activity has peaked
Pharmaceutical-chemical	CT	P 3 L 1 T 0	P 5 L 1 T 0	P +1 L +1 T 0	Laboratory expansion in progress

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[a] P = pathologist, L = laboratory-animal specialist, T = toxicologist, A = administrator, M = manager, C = clinical pathologist, CDTS = clinical development or technical services specialist.

TABLE 10-8

Summation of Employment Slots by Veterinary Specialty as Employed in Industrial and Contract Research Laboratories[a]

Veterinary Specialty	No. Employment Slots Reported by 12 Laboratories		Annual Change,	Projected Additional Slots,	Projected Annual Change,
	1978	1981	1978-1981, %	1984	1981-1984, %
Pathology	55	69	+8	14	+7
Laboratory-animal Medicine	14	20	+14	4	+6
Toxicology	9	7	-7	1	+4

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[a] Data from Table 10-7. Isolated entries listed as manager, administrator, or specialist in clinical development or technical services are excluded.

TABLE 10-9

Employment of Veterinary Specialists in Industrial and Contract Research Laboratories, as Reported in 1978 National Survey of Laboratory Animal Facilities and Resources[a]

Specialty	1978 Employment Persons	1978 Employment FTE[b]	Estimated Additional Need by 1983 Persons	Estimated Additional Need by 1983 FTE[b]	Calculated Projected Annual Change 1978-1983, %
Pathology	65	38.7	61	36.3	9.7
Laboratory-animal medicine	114	70.7	67	40.8	7.3

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[a] Data extracted from Tables 11 and 12b of National Research Council.[2]

[b] Full-time equivalents.

TABLE 10-10

Analysis of Specialty-Board Membership[a]

Board or College	1968	1972	1976	1981
Veterinary Public Health/ Preventive Medicine	111	141	267	337
Veterinary Radiology	20	39	52	81
American College of Theriogenologists	–	28	45	99
Veterinary Toxicology	8	14	32	40
Veterinary Ophthalmology	–	24	38	65
American College of Laboratory Animal Medicine	107	159	238	278
American College of Veterinary Microbiologists	76	115	142	179
American College of Veterinary Pathologists	182	263	371	523
American College of Veterinary Surgeons	36	71	117	180
American College of Veterinary Anesthesiologists	–	–	7	31
American College of Veterinary Internal Medicine				
Cardiology	–	–	18	27
Dermatology	–	–	13	19
Internal Medicine	–	–	42	64
Neurology	–	–	9	18
Total	540	854	1,391	1,941

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[a] Data from AVMA.

TABLE 10-11

Journal of the American Veterinary Medical Association
Classified-Advertisement Analysis
(Nov. 1, 1972-1981)

Specialty	1972	1974	1976	1978	1980	1981
Small-animal practice	43	74	53	67	92	105
Mixed-animal practice	16	12	8	12	14	23
Large-animal practice	8	6	5	10	9	21
Administration	1	1	1	–	4	1
Anatomy	–	–	1	1	–	1
Aquatic-animal medicine	1	1	–	1	–	1
Avian medicine	–	–	–	1	–	2
Clinical specialties[a]	1	–	–	–	2	–
Employment service[b]	–	1	2	2	2	2
Epidemiology, public health	1	1	1	–	2	1
Ethology	–	1	–	–	–	–
Genetic engineering	–	–	–	–	–	2
Immunology	–	–	–	2	3	1
Industrial, sales	1	2	–	–	–	–
Internal medicine	1	10	9	7	7	–
Laboratory-animal medicine	–	1	1	3	–	1
Microbiology	–	1	–	–	1	5
Ophthalmology	–	–	1	1	1	–
Parasitology	–	–	–	–	1	1
Pathology	–	3	6	6	7	6
Physiology	1	3	–	1	–	–
Regulatory	1[b]	1[b]	–	–	1	–
Residencies, internships, assistantships[b]	–	1	–	1	1	2
Surgery	2	2	3	8	4	1
Theriogenology	–	1	1	1	1	–
Toxicology	–	–	–	1	4	1
Total	77	122	92	125	156	177

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[a] Anesthesiology, cardiology, radiology.

[b] Advertisement, Unspecified Number of Openings.

TABLE 10-12

Correlation of Veterinary Specialty Disciplines with Demand Indicators[a]

	Discipline																	
Demand Indicator	Biochemistry	Clinical Specialties	Environmental Health Sciences	Epidemiology, Preventive Medicine	Ethology	Genetics	Immuno-biology	Laboratory Animal Science and Support	Microbiology (Bacteriology, Virology, Mycology)	Molecular Biology	Neurosciences	Nutrition	Parasitology	Pathology	Pharmacology	Physiology	Reproductive Biology	Toxicology
Veterinary specialty-board memberships	–	X	–	X	–	–	–	X	X	–	X	–	–	X	–	–	–	X
Multiple job listings (3 or more since 1976)	–	X	–	X	–	–	X	X	X	–	–	–	–	X	–	–	–	X
Disciplines needed to comply with legislation (7 or more citations)	X	X	X	X	–	X	–	X	X	–	X	–	–	X	X	X	X	X

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[a] Data from Tables 10-10, 10-11, and 11-2.

EFFECT OF FEDERAL LEGISLATION ON SUPPLY AND DEMAND

The Committee surveyed the current legislation and regulations that are pertinent to the use of biomedical manpower and selected those in which veterinary manpower is either specifically required or frequently used. The legislation is shown in Appendix B with the relevant agency, the citation, and a summary of selected provisions of the legislation. Federal agency representatives were asked to project their veterinary specialty manpower needs for 1985 and 1990. The results are shown in Appendix G. The information was requested on November 12, 1980, and most responses were received in 1981. Since the responses were received, some federal regulatory activities have been cut to a point that had not been anticipated. It was the consensus of the Committee, however, that the effects of federal legislation and regulations on veterinary manpower are indirect, as well as direct, and the Committee examined both components.

A direct effect comes from authority given to a government agency to implement regulations that require hiring of personnel to carry out the purpose of the legislation. For example, if legislation increases the regulation of animal welfare in biomedical research facilities, veterinarians must be assigned this task, and thus either new veterinarians are hired or current staff members are reassigned.

An indirect effect of that legislation is recognition by biomedical research institutions that, because new standards are being promulgated, veterinarians must be hired to ensure compliance. A further indirect effect of legislation may be the awareness that standards are changing, new technologies are being developed and supported, and the public is demanding more protection from products or better quality control. Such indirect effects followed the introduction of TOSCA and the creation of EPA. Industry recognized that improved toxicologic testing, monitoring, and research were necessary to meet new demands of society. This resulted in the hiring of more professional staff and in recognition of the fact that veterinarians trained in various specialties would be required.

A further indirect effect of legislation is the perceived climate of public awareness, separate from direct government overview and liability, that applies pressure to the system for the hiring of new personnel to meet societal needs. Industry concerns about the safety and efficacy of new drugs and chemicals lead to improvement in quality control and safety assessment, thus possibly increasing the demand for staff.

The impact of legislation must therefore be evaluated in terms of funding and direct effects on hiring (e.g., federal regulatory agencies), indirect effects on segments of society that must react to the legislation (e.g., the pharmaceutical industry), and the changing pressures for compliance brought to bear by the public, the government, and the legal system. The very complexity of the impact of legislation has limited the Committee's ability to deal accurately with the subject. A single piece of legislation may have slight impact; taken with a series of other enactments, it may exert indirect pressures that have a significant impact on demand. We have therefore chosen to examine in detail the actual components of demand, determining current staffing and predicted staffing. This information can then be examined in relation to enactment of legislation in a way that is pertinent to either direct or indirect impact.

The Committee analyzed the projected demand for veterinary specialists in relation to specific legislation and regulations by function (Table 11-1) and by biomedical specialty (Table 11-2). This approach was taken because analysis by function reveals manpower needs that specialists other than veterinarians might be sought to fill and analysis by specialty indicates shortages related to specific disciplines so that training can be sought to meet those shortages.

Government-agency representatives were asked to indicate which biomedical disciplines were used to implement legislation and whether veterinarians were required to fulfill the various functions defined in

Chapter 6. Laboratory-animal science and support, pathology, and toxicology were most often described as biomedical disciplines in which veterinarians were required and in high demand. For the other disciplines listed, the veterinary degree was described as highly desirable, but not necessarily required, because of the availability of persons with Ph.D.s or other advanced training in the desired fields of study. Of the functional responsibilities, veterinarians in animal welfare and animal health care were believed most needed, with administration also cited often as needing veterinarians.

Correlations in Tables 11-1 and 11-2 are marked with an X. Specific estimates of the manpower needs for each function and discipline depend not only on the requirements explicit in the legislation and regulations, but also on the funds appropriated. For instance, no funds have yet been appropriated for enforcement of the Animal Cancer Research Act (PL 96-469), which was approved in 1980. Table 11-2 indicates that most biomedical specialties in which veterinarians can serve are applicable to the implementation of the various legislation and regulations listed. No numbers are attached to these specialties, for two reasons: uncertainties in extent of funding and enforcement prevent numerical estimates from being made, and switching among the biomedical disciplines is very common,[1] so shortages in a given field can be filled by persons with training in closely related fields. Thus, although all these disciplines will be used, not all are predicted to have shortages during the 1980s.

In gathering the data for Table 11-2, it was pointed out that veterinarians with specialty training in pathology, toxicology/pharmacology, and laboratory-animal medicine are seen to constitute the groups that will feel the primary impact of legislative and regulatory developments. The veterinarians with specialty training in these fields are most suitable to conduct and assess research on drug and chemical toxicity and safety. Growing public concern about potential environmental health hazards has resulted in pressures on the various government regulatory agencies. As a result, a variety of laws, regulations, and policies have been instituted or proposed that require animal testing to assess toxicity and safety of drugs, chemicals, and environmental contaminants.

The collective findings of the Committee concerning the potential impact of legislative and regulatory developments on non-private-practice veterinary specialists indicate that employment would typically result in 3 categories:

- Regulatory agencies, such as USDA, FDA, and EPA.
- Industrial and contract laboratories performing toxicity and safety studies on drugs, chemicals, and environmental contaminants.
- Academic institutions that train veterinary specialists.

As shown in Table 9-2, employment of veterinary specialists by the major U.S. regulatory agencies potentially affected by such legislation (USDA, FDA, and EPA) remained relatively constant from the early 1970s to 1980. Although a 1978 survey by A. D. Little, Inc.,[2] had projected an annual increase of 2.0-5.2% in veterinarians in the federal agencies, such as FDA, the additional data now available indicate that employment of veterinary specialists in the regulatory agencies has stabilized.

As shown in Table 10-9, data now available indicate that demand for veterinary specialists in pathology and laboratory-animal medicine increased from 1978 to 1981. Preliminary projections also indicate an annual increase of 6-7% during 1981-1984 for these two specialty groups in industrial and contract research laboratories. Additional data are needed to identify the long-range trend in this type of employment.

No specific data were available to assess the potential impact of legislative and regulatory developments on veterinary specialties in academic institutions. This aspect is addressed with a general model in Chapter 9.

The Committee recognizes the potential discrepancies among the apparent future employment opportunities predicted by past employment practices, by current administrative actions, and by the needs implicit in existing and developing legislation and regulations.

REFERENCES

1. National Research Council, Committee on a Study of National Needs for Biomedical and Behavioral Research Personnel. 1981. Personnel Needs and Training for Biomedical and Behavioral Research. Washington, DC: National Academy Press. 159 pp.
2. Little, A. D., Inc. 1978. Veterinary Supply and Demand in the United States. A Report to the American Veterinary Medical Association, Cambridge, MA: A. D. Little, Inc. 173 pp.

TABLE 11-1

Demand for Veterinary Activities According to Functional Responsibilities Needed to Comply with Legislation and Regulations

	Functional Responsibilities									
Legislation or Regulations	Administration	Animal-Health Care	Animal Welfare	Biomedical Research	Economic Productivity	Environmental Health Protection	Food Production and Protection	Health Education	Mental and Emotional Health	Zoonosis Prevention
Animal Cancer Research Act	X	X	X	X	-	-	X	X	-	X
Animal Welfare Act	X	X	X	-	-	-	-	-	-	-
Clean Air Act	-	X	X	X	-	-	-	-	-	-
Consumer Product Safety Act	-	X	X	-	-	-	-	-	-	-
Federal Food, Drug, and Cosmetic Act	X	X	X	X	-	-	X	-	-	-
Federal Insecticide, Fungicide, and Rodenticide Act	-	X	X	X	-	-	-	-	-	-
Federal Water Pollution Control Act	-	X	X	X	-	X	-	-	-	-
Good Laboratory Practice Regulations	X	X	X	-	-	-	-	-	-	-
Occupational Safety and Health Act	-	X	X	X	-	-	-	-	-	-
Resource Conservation and Recovery Act	-	-	-	-	-	-	-	-	-	-
Safe Drinking Water Act	-	X	X	X	-	X	-	-	-	-
Toxic Substances Control Act	-	X	X	-	-	-	-	-	-	-
USDA Regulations	X	X	X	X	X	-	X	-	-	X

TABLE 11-2

Demand for Veterinary and Other Biomedical Personnel According to Discipline Needed to Comply with Legislation and Regulations

Legislation and Regulations	Discipline																	
	Biochemistry	Clinical Specialties	Environmental Health Sciences	Epidemiology, Preventive Medicine	Ethology	Genetics	Immunobiology	Laboratory-Animal Science and Support	Microbiology (Bacteriology, Virology, Mycology)	Molecular Biology	Neurosciences	Nutrition	Parasitology	Pathology	Pharmacology	Physiology	Reproductive Biology	Toxicology
Animal Cancer Research Act	X	X	X	X	-	X	X	X	X	X	X	X	X	X	X	X	-	X
Animal Welfare Act	-	X	-	-	X	-	-	X	-	-	-	-	-	X	-	-	-	-
Clean Air Act	-	-	X	-	-	-	-	X	-	-	-	-	-	X	-	-	-	X
Consumer Product Safety Act	X	-	X	X	-	X	-	X	X	-	-	-	-	X	X	-	-	X
Federal Food, Drug, and Cosmetic Act	X	X	X	X	-	-	X	X	X	X	X	X	X	X	X	X	X	X
Federal Insecticide, Fungicide, and Rodenticide Act	X	-	X	X	-	X	-	X	X	-	X	-	-	X	X	X	X	X
Federal Water Pollution Control Act	X	-	X	-	-	X	-	X	X	-	-	-	-	-	X	X	X	X
Good Laboratory Practice Regulations	X	X	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X
Occupational Safety and Health Act	X	X	X	X	X	X	X	X	X	X	X	-	-	X	X	X	X	X
Resource Conservation and Recovery Act	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Safe Drinking Water Act	X	-	X	X	-	X	X	X	X	X	X	X	X	X	X	X	X	X
Toxic Substances Control Act	X	X	X	X	-	X	-	X	X	-	X	-	-	X	X	-	X	X
USDA Regulations	X	X	X	X	-	X	X	X	X	X	-	X	X	X	X	X	X	X

12

CONCLUSIONS AND RECOMMENDATIONS

The foregoing chapters have described in detail many aspects of veterinary manpower, research, and education. Present conditions and the historical context of their development have also been described. The comments and projections in the text are the foundation on which the future of veterinary specialty manpower may be extrapolated. Although this foundation is critical to an understanding and appreciation of the present status of veterinary manpower in the United States, its relevance depends on the development of reliable predictors of future directions for veterinary employment. Thus, we have selected specific subjects on which there was a strong consensus in support of the formulation of recommendations for meeting the needs of society for veterinary medical specialists. These recommendations were developed by a process of data-gathering and analysis, and the application of the collective judgment of the Committee members and consultants. Recommendations 1, 2, and 3 were developed on the basis of the data shown in Chapters 9 and 10; the other recommendations rest upon weaker or less complete data bases, representing the judgment of the Committee based upon their collective experience.

DEVELOPMENT OF DATA ON VETERINARY SPECIALISTS

As discussed in detail in Chapters 9-11, there are major deficiencies in our data base with respect to the number and functions of veterinarians not in private practice. The two major concerns are related to the industrial sector and the schools of veterinary medicine. Although the Committee used a variety of sources and data, adequate input from the industrial sector is not available. This needs to be accumulated now and continuously in the future. A detailed breakdown of the roles of veterinarians and their fields of specialization in veterinary medical schools also is unavailable. The prospectus for a survey document was assembled as part of this report (Appendix F), and the development and use of such an instrument would be appropriate to supply the missing information for projecting the trends and needs for the coming decade. This or a similar survey instrument could be distributed by a group within the veterinary profession that already conducts periodic surveys of veterinarians, including distribution and specialties. The agencies and associations that have surveys in progress could modify their present ways of accumulating data, to develop a more complete data base that would be valuable in projecting future needs for people with advanced training and experience in veterinary medical sciences.

Although our data base for 1970, which was obtained from various sources, agreed with the Terry report, it was the considered opinion of the Committee that there were some deficiencies in the available data. Specific comments are cited in Appendix D; the prospectus for a survey document (Appendix F) was developed to fill in these data gaps and to provide a more complete and reliable accounting for determining future manpower needs.

The Committee offers the following specific recommendations:

Recommendation 1: National Reporting System

The Committee recommends that a comprehensive national reporting system be developed to determine accurately the number of veterinarians being used in all fields of employment. This should either be an expansion of the existing AVMA system or be developed in conjunction with the existing system.

SUPPLY OF VETERINARIANS THROUGH 1990

Information that will be generated as a result of the recommendation above can be used to monitor closely the supply of and demand for veterinarians. With current information, it is the judgment of the Committee that the supply of and demand for veterinary manpower are approaching a balance. It is anticipated that a modest surplus in supply will occur by 1990; however, some regional shortages will continue.

Recommendation 2: Stabilization of Number of Veterinary Graduates

The Committee recommends that educational opportunities at the D.V.M. level be stabilized at the current number. The number of veterinary graduates appears to be in balance with manpower and service needs. Schools adversely affected by the cessation of capitation funding should consider decreasing their enrollments, to maintain the quality of professional training and to be able to provide postdoctoral training for veterinarians needed by the non-private-practice sector. Increases to meet regional needs should be accompanied by decreases in regions that are training veterinarians in excess of their own needs. Other ways to stabilize veterinary manpower include early retirement, retraining in midcareer, and programs specifically designed to deal with regional imbalances in numbers of practitioners.

EDUCATIONAL INFLUENCES

The demand for veterinarians in activities related to clinical patient care of animals appears not to exceed supply through the 1980s. The policies, admissions criteria, and program priorities of the colleges of veterinary medicine for the last two decades have emphasized individual animal patient care. The interests of society are also served by using veterinarians in many fields other than direct patient care. The strong basic-science emphasis in veterinary education, coupled with skill in solving clinical problems, is a resource of value in many occupations. It is essential that veterinary medical educators select students capable of responding to society's needs for persons in these occupations, continue to provide strong basic-science education, and expose students to these new opportunities.

Recommendation 3: Veterinary Medical School Programs

a. The Committee recommends that the colleges of veterinary medicine adjust their curricula, admissions criteria, and clerkship programs to meet societal needs in environmental health protection, food production and protection, economic productivity in animal-related industries, biomedical research, and animal welfare, as well as needs for clinical patient care of animals.

b. The Committee recommends that national guidelines for postdoctoral educational programs at veterinary colleges be established. The AVMA Council on Education should create or sponsor a special group to develop guidelines and evaluate graduate programs according to those guidelines.

POSTDOCTORAL TRAINING SUPPORT

Postdoctoral specialization should receive additional emphasis. Program expansion must be keyed, however, to the availability of high-quality applicants and to the resources needed and available to produce high-quality programs.

The demand for veterinarians with postdoctoral specialty training will depend heavily on federal legislation and budgets. It is anticipated that demand for capable and appropriately trained specialists will exceed supply through the 1980s. This demand will be greatest in toxicology, pathology, laboratory-animal medicine, and research on disease prevention and health care of food-producing animals. One way to meet this demand is through the development of combined DVM/PhD programs of shorter duration. One must be cautious, however, in equating increased demands for specialists with what society will actually support. Future demand will also be influenced by the quality of training. Postdoctoral training of veterinarians is a responsibility of the entire biomedical community. Veterinary-school graduate programs should be evaluated formally to encourage high standards.

The costs of continuing education after the veterinary degree need to be examined, in view of the expected salary that can be obtained after such additional training. The current disparity between salaries of veterinarians and those of other health professionals in competition for similar jobs may be a major deterrent to persons considering advanced specialty training. A combined DVM/PhD program is one way to provide this training at a potentially lower cost.

Recommendation 4: Support for Postdoctoral Training

The Committee recommends that postdoctoral training for veterinarians be given high priority for support by federal and state government agencies responsible for financing higher education.

ROLE OF VETERINARIANS IN GOVERNMENT SERVICE

The federal government is the largest employer of veterinarians in the world, employing veterinarians in all functions, as developed in Chapter 6, and in most of the biomedical disciplines, as shown in Chapter 11.

Government and other potential employers of veterinarians should be encouraged to examine critically the expanded roles that veterinarians can assume, the value of veterinarians' broad training in biomedical sciences and health care, and the cost-effectiveness of increased use of veterinary services in all the functional responsibilities already described. The unique training and expertise of veterinarians should be emphasized and more widely recognized, so that job descriptions in government service will reflect their unique qualifications. More realistic government service (GS) ratings should be assigned to veterinarians with specialty training, to make such positions more competitive with other employment opportunities.

Recommendation 5: Increased Recognition of Veterinarians as Biomedical Scientists

The Committee recommends that use of veterinarians' biomedical expertise by government agencies be increased. Agency heads should be made aware of the skills, knowledge, and unique qualifications of veterinarians, which could contribute to meeting the agencies' program goals and responsibilities. Thorough evaluation of the contributions and productivity of veterinary biomedical scientists in the fields of concern to federal and state agencies is encouraged to inform decisions about future selection of personnel from among the various health professional and paraprofessional manpower resources.

FOOD-ANIMAL VETERINARY PRACTICE

Perceived shortages of veterinarians continue in some livestock-producing regions of the United States. Demographic data indicate that numbers of food-animal practitioners increased little during the last decade. The problem is in large part a matter of the economics of food-animal veterinary practice. Areas with perceived shortages commonly do not provide satisfactory remuneration to veterinarians for services rendered as food-animal veterinary medicine is currently practiced. Some food-animal practices enable veterinarians to supplement their incomes through companion-animal practice. Methods for providing expanded community services, and thereby providing economically sound food-animal practice opportunities, should be explored.

Economic models can be useful in demonstrating the delivery by veterinarians of needed new services to rural communities and the livestock industries. Services that can be examined by such modeling include the marketing of agricultural chemicals, pharmaceuticals, rodenticides, insecticides, livestock equipment, and livestock feed additives and supplements. Furthermore, the offering of animal-health training courses for livestock producers by local veterinarians should be studied, including methods of course preparation assistance. For modeling studies, multidisciplinary research involving veterinarians and agricultural economists should be encouraged. Such research would of necessity be based on a thorough understanding of market systems.

Recommendation 6: Participation of Veterinarians in Economic Modeling and Agribusiness

The Committee recommends that economic models be developed for the application of animal-health expertise to the livestock industries, possibly through the provision of expanded community or other agribusiness services. Multidisciplinary research involving veterinarians and agricultural economists should be encouraged. Economic modeling is one technique that should be explored in an effort to deliver veterinary services to underserved areas.

APPENDIX A

REPORT ON THE PRESENT AND ANTICIPATED ROLE OF VETERINARY PHARMACOLOGY, TOXICOLOGY, AND THE ENVIRONMENTAL SCIENCES IN BIOMEDICAL RESEARCH AND EDUCATION

(NOVEMBER 15, 1978):
CHAPTERS IV, VI, AND VII AND PERTINENT REFERENCES

Prepared by E. Murl Bailey (Texas A&M University), Lloyd E. Davis (University of Illinois), Ralph W. Fogleman (Ringoes, New Jersey), Marvin A. Norcross (U.S. Food and Drug Administration), Fred W. Oehme (Kansas State University), Samuel F. Scheidy (Bryn Mawr, Pennsylvania), and Nicholas H. Booth (University of Georgia), Coordinator.

IV. EXPANDED and/or ANTICIPATED ROLES OF VETERINARY PHARMACOLOGY, VETERINARY TOXICOLOGY, and the VETERINARY ENVIRONMENTAL SCIENCES in RELATION to PUBLIC HEALTH

A. Expanded Role in Agricultural Sciences. In addition to the general increasing support that veterinary medicine offers the agricultural sciences, the increased use of chemicals in agricultural practice will demand that veterinary pharmacology, toxicology, and environmental health play an even greater role within the profession. The current trend in agricultural practice is away from the more stable less toxic chemicals to the use of less persistent but highly poisonous compounds in insect, weed, fungus, and predator control. At the same time, the pharmaceutical industry is developing more specific and potent compounds for use in the prevention and treatment of livestock diseases. Many of these new drugs are intended for lay use. The availability of such potent chemicals to relatively untrained personnel increases the hazard and potential for toxic effects. It will fall to veterinary pharmacology and toxicology to learn about such potentially toxic effects and provide trained veterinarians to handle the situations that may develop from such use of chemicals.

B. Expanded Role in Prevention of Human Toxicities. The veterinary profession, especially specialists in pharmacology and toxicology, has an additional important role in the prevention of human toxicities from the use of agricultural chemicals and drugs. This public health emphasis is a natural consequence of the common use of these potent chemicals by livestockmen and other agriculturalists. The experimental pharmacologist and toxicologist is invaluable in documenting the effects of these chemicals in laboratory animals, and in predicting and alerting the human population for possible human hazards. The toxicologist, who also is concerned with chemicals produced by animals that are potentially toxic to humans (biotoxins), is also valuable in the prevention of human health problems by alerting and consulting with public health officials in situations of venomous animal bites or exposure. Poisonous plants, a common source of poisoning in children as well as adults, must also be recognized, information concerning their hazard distributed, and assistance offered in instances of exposure to these toxic materials. The veterinary toxicologist and pharmacologist plays an important role in public health by assisting preventive medicine in reducing the human hazard from agricultural chemicals, environmental toxins, and animal and plant poisons.

C. Expanded Role in Assessment of Food Safety. It is anticipated that veterinarians will be utilized to a much greater degree in food toxicology and hygiene (Russell, 1973). The veterinarian's present role in food safety includes major responsibilities in areas of food, animal health, inspection of raw food products, and protection of food from contamination or adulteration during processing (Lane, 1968). Approximately 10% of the total number of veterinarians in the United States are employed either full or part time in food inspection of some type (Committee on Veterinary Medical Research and Education, 1972). Veterinarians are also serving in the food safety and nutrition programs of the space program of the National Aeronautics and Space Administration (Heidelbaugh et al., 1973). Also veterinarians of the FDA Bureau of Veterinary Medicine are heavily involved in safety measures involving animal feeds (Van Houweling et al., 1977) and animal drugs (Wagstaff, 1977). With an increase of chemicals entering the environment, it is anticipated that a greater number of veterinarians will be needed with training in pharmacology and toxicology to safeguard against the entry of these substances in animal feed and, subsequently, into the human food supply. Both the FDA and EPA are expected to require more veterinarians in the future for regulatory control purposes. Also, the role of veterinarians in the toxicological evaluation of drug or chemical residues in slaughter house animals is anticipated to increase within the USDA. The USDA is not only concerned with protecting the consumer against misbranded meat and meat containing infectious agents, but is also actively involved in safety evaluations involving the addition of chemicals to food; this federal regulatory activity also involves the expertise of veterinarians (Engel, 1977).

D. Expanded Role in Clinical Toxicology. A recent concern of public health officials has been the hazards to human health associated with the indiscriminate use of drugs and chemicals in animals, in the human environment, and directly on people. While reactions such as hypersensitization may occasionally be expected due to pesticide use around people or directly on the skin, it is less recognized that potentially dangerous effects in reducing immune responses, in altering liver function, in changing body metabolism, and in altering the resistance of the ever-present microorganisms offer additional dangers to human health. Certain antibiotics are notorious for producing drug resistant strains of bacteria that could produce a resistant population of pathogenic bacteria. Such complex interactions, and such various intricate and subtle manipulations of the human biochemistry, are areas that are not often addressed by scientists. Veterinary pharmacologists and toxicologists, with their capability of utilizing experimental animals and understanding of the vastly differing biochemistry in animal species and its relationship to human beings, offer a broad capability for generating information that could be of substantial help in reducing human health hazards due to chemicals and drugs.

The close relationship between human beings and animals has often led to the occurrence of poisonings in animals prior to their detection in humans. In such instances, it is imperative that the clinical and diagnostic facilities of the veterinarian be accurate and prompt in their response and diagnosis of the chemical problem in animals. The well publicized polybrominated biphenyl (PBB) episode in Michigan is an ideal example of such a situation (Jackson and Halbert, 1974; Kay, 1977). Had the diagnosis of poisoning in affected livestock been recognized promptly, much subsequent loss of animals could have been avoided and the majority of the controversial human health claims could have been prevented. Such diagnostic capability, however, requires that a considerable cadre of scientific expertise be available and that this scientific core be supported with adequate diagnostic facilities. It further requires that a strong liaison be made available between the veterinary and human health professions so that information generated in the veterinary sector can be promptly and seriously considered by public health officials. The veterinary toxicologist serves a major role in such a function, since his primary training is related to the recognition and treatment of chemical disorders in animals. Such disasters, which occur with alarming frequency, are potentially of wide concern through the current efficient food distribution channels which provide our human population with its nutrition. Adequate veterinary toxicology facilities are vitally needed throughout the United States to protect the human food chain from potential chemical contamination, and to detect animal exposures to chemicals so that appropriate actions may be taken to avoid dissemination of such contaminated products throughout the human food supply.

In addition to presenting public health personnel with indicators of human hazards, a more direct goal may be played by the veterinarian, particularly the veterinary toxicologist and clinician, in instances of medical emergencies or disasters that place a serious strain upon the available human medical resources. Delivery of health care for humans in such situations could easily be supplemented by the assistance of veterinarians. The qualifications of veterinary clinicians, toxicologists, and pharmacologists who are familiar with biomedical techniques, physiological monitoring and support, and application of appropriate medication, would serve a valuable supportive role to physicians dealing with catastrophes. Such assistance would even be more apropos if the particular disaster involved a chemical exposure in which animals had previously been involved. Experience gained by veterinarians in dealing with animal cases would be of great benefit to the human health personnel seeking to support and treat people affected with similar disorders. The common sense training and practicality instilled in graduates of Colleges of Veterinary Medicine would also be of benefit in dealing with massive exposure of persons to chemical or physical insult and in dealing with such instances on an efficient and rational basis.

E. Expanded Role in Collaboration with Other Health Disciplines. The collaboration of veterinarians, and particularly veterinary pharmacologists, toxicologists and environmental scientists, with other health related areas is an important necessity for the continuing development of an adequate and complete total health program for the United States. Each medical discipline is uniquely trained in its own specialty: i.e., physicians, dentists, and nurses in human medicine, pharmacists in clinical pharmacy, and veterinarians in animal health. According to Gibson (1975), an M.D. and International Editor of the news magazine, M.D., "There was never a time when veterinary and human medicine needed to be closer together than they do today. The reciprocity of knowledge is extremly important between both of these vital disciplines."

Collectively, the total spectrum of care for our animal and human population in this country could be fully monitored and protected. The increasing interest and necessity for trained personnel in toxicology, however, provides the veterinarian with an exceptional opportunity to offer his unique expertise. Through diverse training that includes competency in anatomy, physiology, pathology, pharmacology, toxicology, and clinical medicine of all species of animals, the veterinarian is especially qualified to perform studies investigating the toxicity of foreign chemicals (xenobiotics). Such studies are always extensively conducted in a variety of experimental animals, and it is in this area that his knowledge of comparative physiological, biological, and pathological changes will offer the opportunity for significant contributions.

F. Expanded Role in Tropical Medicine. An anticipated role of increasing dimension for veterinary pharmacologists and toxicologists must also include research in tropical medicine involving human beings and animals. Six infectious diseases that are almost unknown in the United States plague Africa, Asia, and Latin America (Eisenberg, 1977). For example, malaria afflicts an estimated quarter billion people; the mosquito that spreads it is becoming resistant to the conventional pesticides and the plasmodium to chloroquin. Trypanosomiasis afflicts probably 20 million people; an effective agent against either the vector or the parasite is lacking. The treatment for trypanosomiasis can be more dangerous than the disease. Leishmaniasis claims some 12 million people and no known treatment is available. Filariasis and onchocerciasis ("river blindness") infect 300 million individuals and treatment of these diseases is unsuccessful. Ocular lesions, which are the most serious result of onchocerciasis, eventually cost the victims their eyesight (Bazin, 1978).

Schistosomiasis afflicts 250 million people; as the developing nations attempt to improve their agricultural productivity through irrigation of cropland, the snail vector increases. Also, there are 12 to 15 million individuals who have leprosy; present therapy of the disease requires seven years and is becoming more complex to control because drug-resistant lepra bacilli have begun to appear. According to Eisenberg (1977), "In the face of all this, there is a clear moral imperative in developed nations for medical research in tropical diseases, to seek to permit two-thirds of the world's population to share in the freedom from pain and untimely death we have achieved for ourselves."

G. Expanded Role in Environmental Pharmacology and Toxicology. As interest continues to mount in the development of chemical means to control disease, increasing concern will develop for possible toxicity involved with the use of these new chemicals in not only man but also in non-target animals and the environment. Thus, preliminary studies and toxicological evaluations in a wide variety of animals are necessary to determine the scope and severity of any such potential dangers. Drug evaluations, safety studies, and concern for general public and environmental health require not only that such evaluations be thoroughly and competently performed, but that veterinarians with their diverse and unique training be utilized as the core scientists in developing, conducting, and evaluating such studies.

There is every indication that the need for trained toxicologists and pharmacologists will increase and is occurring just at a time when the funding for training programs in Colleges of Veterinary Medicine is decreasing or at the best stabilized. Because of the public interest that will be served by generating more trained toxicologists and pharmacologists with a veterinary medical orientation, the support for such training programs should be increased. It is only through the adequate support of high quality students that the public interest will be served by producing adequate numbers of these highly trained scientists.

VI. SUMMARY

During the last two to three decades, disciplines such as veterinary pharmacology and veterinary toxicology as well as others in veterinary medicine have contributed greatly to the advancement of knowledge in the agricultural, biomedical and environmental sciences. Despite the well-documented contributions in advancement of the welfare of society by these disciplines, there are critical manpower shortages of veterinary pharmacologists and toxicologists. With drugs and chemicals being used of necessity in ever increasing quantities to control and treat animal diseases as well as to improve animal and crop production, the need to train more individuals in veterinary pharmacology and toxicology becomes increasingly apparent.

Use of drugs in animal production has expanded to the degree that approximately 80% of all animals produced for food purposes receive medication for part or for most of their lives. Eventually, it is anticipated that nearly all animals produced in the United States for food will have received a chemotherapeutic or prophylactic agent of some type. As drug and chemical use in animal and crop production increase as well as contamination of the environment from chemical pollution, the possibility of human exposure to them is also increasing. Consequently, questions relating to toxicities such as allergenicity, mutagenicity, teratogenicity and carcinogenicity of these residual substances in the food, air, and water supply must be answered. Moreover, the importance of drug metabolism in the target species and in the human being (residues consumed in meat, milk and eggs) for the evaluation of drug safety is steadily increasing. Veterinary pharmacologists and toxicologists routinely make significant contributions toward the acquisition of answers to these questions regarding the safety of the nation's food supply. This leads to the continuous improvement in the quality and efficiency in the procurement of such information. For example, programs to develop rapid monitoring tests for the detection of drug residues in food animals are continually under exploration by veterinary pharmacologists and toxicologists in the FDA, USDA and other laboratories. The public health duties performed by the veterinary pharmacologist and toxicologist are, therefore, extremely important in the maintenance of quality health standards. It is well known that most feeds consumed by animals and food consumed by human beings contain residual amounts of drug or chemical residues. The potential hazards to human health in this situation are evident; however, at the present there is no known case where legal residues have produced deleterious effects in human beings. This type of safety record is not accidental and can be attributed to the acquisition of toxicological data from which the all important tissue tolerance levels for drug or chemical residues are derived. Regulatory agencies such as the FDA, EPA, and USDA are dependent upon this type of information to insure against the possibility that drugs, pesticides, and chemicals in general do not contaminate the feed and food supply of animals and the human being above the established tolerance levels.

Another increasingly important area in which veterinary pharmacologists and toxicologists are involved is the determination of the effect of environmental chemicals and pollutants upon the pharmacokinetic parameters of drugs as well as change in toxicity of drugs. It is well known that drug interactions occur which may induce extreme alterations in the metabolism of drugs. The extent to which chemical contaminants or xenobiotics in the environment may be capable of triggering interactions following long term or chronic exposure in animals and the human being is essentially unknown.

It is anticipated that the delivery of health care for humans, particularly in clinical pharmacology and environmental toxicology will be easily complemented by the assistance of veterinarians. The qualifications of veterinary pharmacologists, toxicologists, and clinicians who are familiar with biomedical techniques, physiological monitoring and support, and application of appropriate medication, could serve a valuable supportive role to physicians dealing with mass health catastrophes.

Other areas that are in the developmental stage that will require a greater number of veterinary pharmacologists and toxicologists are in behavioral toxicology and behavioral neurochemistry. Also, in research involving tropical medicine, veterinary pharmacologists and toxicologists will be in increasing demand by medical laboratories as well as the chemical and pharmaceutical industries.

There are over 4 million recognized chemical compounds in existence today and nearly 250,000 new ones are synthesized annually with about

1000 of these being marketed each year. It is estimated that 30-40% of all malignant neoplasms in the human being are caused by exogenous and environmental factors. The uncontrolled entrance of chemicals into the environment is considered to be an important factor. Consequently, the need for better control of toxic substances has been pointed up by a series of mass health disasters involving polychlorinated biphenyls, polybrominated biphenyls, mercury, hexachlorobenzene, dioxins, and cadmium. The control of toxic substances has been initiated with the passage of the Toxic Substances Control Act (TSCA) of 1976. With passage of TSCA a greater number of veterinary toxicologists and pharmacologists will need to be trained.

Last but not least is the important role that veterinary pharmacologists and toxicologists contribute in the training of veterinary medical students as well as graduate students at the Master of Science and Doctor of Philosophy levels. Pharmacology and toxicology have been neglected disciplines in most colleges of veterinary medicine and need to be upgraded by staffing and funding before quality training programs can be established. Regional centers or multi-university collaborative programs involving veterinary medicine, pharmacy, medicine, public health and agriculture should be considered to train the pharmacologists and toxicologists required to meet the needs of society.

VII. RECOMMENDATIONS

Based upon a manpower survey as well as upon the present and anticipated roles of veterinary pharmacology and veterinary toxicology, a greater number of individuals trained in these disciplines is recommended to meet the manpower needs of the agricultural, biomedical and environmental sciences. Specifically, this recommendation involves manpower requirements for pharmacologista and toxicologists in:

1. Assessment of safety and efficacy of pharmaceutical agents and chemicals for use in agriculture to assure the production of an ample and safe supply of food for human consumption.
2. Federal regulatory agencies, FDA, EPA and USDA, responsible for enforcement of legislation enacted by the United States Congress. The safety and efficacy of substances from pharmaceutics used in chemotherapy to chemicals added to food or the environment with potential exposure of animals and human beings are regulated by these agencies.
3. Delivery of health care for humans, particularly in clinical pharmacology and clinical toxicology; veterinary pharmacologists, toxicologists, and clinicians who are familiar with biomedical techniques, physiological monitoring and support, and application of appropriate medication, could serve a valuable supportive role to physicians dealing with mass health catastrophes.
4. Research in the development of pharmaceutics and other chemicals for the diagnosis, prevention, control and/or

treatment of animal and human diseases; also, included are research studies involving xenobiotic agents or pollutants of the environment, tropical medicine, comparative pharmacology and toxicology involving various animal models, behavioral pharmacology, and behavioral neurochemistry.

5. Education of veterinary medical and graduate students in pharmacodynamics, pharmacokinetics, clinical pharmacology and environmental toxicology.

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APPENDIX B

CURRENT LEGISLATION AND REGULATIONS AFFECTING DEMAND FOR VETERINARY MEDICAL SPECIALISTS

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Agency	Legislation or Regulations	Citation	Summary of Selected Provisions[a]
Consumer Product Safety Commission (CPSC)	Consumer Product Safety Act, as amended	5 U.S.C. 5314, 5315; 15 U.S.C. 2051-2081 P.L. 92-573 (Oct. 27, 1972) P.L. 94-273; P.L. 94-284 P.L. 95-319; P.L. 95-631	This Act was designed to protect consumers against unreasonable risk of injury from hazardous products. It established the Consumer Product Safety Commission as an independent regulatory commission to perform this function, and authorized the commission to conduct safety studies and tests of consumer products.
Environmental Protection Agency (EPA)	Clean Air Act, as amended	42 U.S.C. 1854 et seq. (1976) 42 U.S.C. 7401 (Supp. III, 1979)	The 1970 Act and the 1977 amendments affected virtually all industrial and transportation activity, the production and use of energy, and real estate development. Its fundamental purpose was to protect public health by cleaning the air. It provided for continuing research into the effects of various substances and activities on the stratospheric ozone layer, authorized EPA to regulate such substances, and required more than a dozen studies concerning air pollution.
EPA	Federal Insecticide, Fungicide and Rodenticide Act, as amended (original law was P.L. 104, June 25, 1947)	7 U.S.C. 135 et seq.	This legislation gave the government broad authority to control pesticides and other pest killers, and required detailed information on these substances, including labels, claims to be made, directions for use, the chemical formula, and test results.
EPA	Federal Water Pollution Control Act, as amended (first law was passed in 1952, with over 20 public laws amending the original)	33 U.S.C. 1151 et seq.	The main objective of the 1972 Act was to "restore and maintain the chemical, physical and biological integrity of the nation's waters." The law also set two additional goals: fishable and swimmable waters by 1983 and elimination of all polluted discharges into navigable waters by 1985. To achieve those goals, the law required all U.S. industries to use, by July 1, 1977, the "best practicable control technology currently available" for treatment of discharges. By July 1, 1983, industries were to use the "best available technology economically achievable."
EPA	Resource Conservation and Recovery Act of 1976 (RCRA)	P.L. 94-580 (Oct. 21, 1976) 42 U.S.C. 6901 et seq.	This Act was designed to provide technical and financial assistance for the development of management plans and facilities for the recovery of energy and other resources from discarded materials and for the safe disposal of discarded materials, and to regulate the management of hazardous waste. It authorized studies on waste recovery and resource conservation.

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[a] Selected provisions taken from the legislation cited.

Agency	Legislation or Regulations	Citation	Summary of Selected Provisions
EPA	Safe Drinking Water Act, as amended	21 U.S.C. 349; 42 U.S.C. 201, 300f to 300j-9	The 1974 Safe Drinking Water Act directed the EPA to establish national standards setting maximum allowable levels for certain chemical and bacteriological pollutants in some 240,000 water systems (those serving more than 25 customers). It authorized funds for research and training programs dealing with safe drinking water and for special projects and demonstrations.
EPA	Toxic Substance Control Act	P.L. 94-469 (Oct. 11, 1976) 15 U.S.C. 2601 et seq.	This Act was designed to regulate commerce and protect human health and the environment by requiring testing and necessary use restrictions on certain chemical substances. It expanded federal regulation of industrial and commercial chemicals and for the first time required premarket testing for potentially dangerous chemicals.
Food and Drug Administration (FDA)	Federal Food, Drug, and Cosmetic Act, as amended (original law was Food and Drugs Act of 1906)	21 U.S.C. 301-392	This legislation includes extensive amendments regarding the purity and safety of food, drugs, and cosmetics, including controls and pre-market testing requirements for chemical additives, color additives, and new drugs. It includes the Delaney Clause in which any chemical additive was prohibited from being used in human or animal foods, at any level, if it was known to cause cancer when fed to laboratory animals.
FDA	Nonclinical Laboratory Studies, Good Laboratory Practice Regulations	Code of Federal Regulations, Title 21, Part 58	Department of Health, Education, and Welfare has issued this as a final rule regarding good laboratory practice in the conduct of nonclinical laboratory studies.
National Institute of Occupational Safety and Health (NIOSH)	Occupation Safety and Health Act of 1970	29 U.S.C. 651 P.L 91-596	The major responsibility of this agency is to provide research and standards-setting support and recommendations for worker protection to the Department of Labor, Occupational Safety and Health Administration (OSHA) under the OSH Act of 1970 and the Mine Safety and Health Act of 1977, as amended. The Institute also has responsibility for the training of occupational health manpower.
U.S. Department of Agriculture (USDA)	Laboratory Animal Act of 1966; Animal Welfare Act of 1970	P.L. 89-544 (Aug. 24, 1966) 7 U.S.C. 2131-2154 P.L. 91-279 (Dec. 24, 1970) 7 U.S.C. 2131 et seq.	Laboratory Animal Welfare Act of 1966 (P.L. 89-544) was enacted to prevent the "dognapping" of pet dogs and cats and their subsequent resale for use in research, and to promote humane treatment of dogs, cats, and certain other laboratory animals by dealers and research facilities. In 1970, the Act was amended to include most live or dead warm-blooded animals and to regulate exhibitors and auction sales.

Agency	Legislation or Regulations	Citation	Summary of Selected Provisions
USDA	Importation of Cattle and Quarantine	21 U.S.C. 101-105	This legislation relates to the Animal and Plant Health Inspection Service requirements for specialty veterinary manpower.
	Prevention of Introduction and Spread of Contagion	21 U.S.C. 111-135b	
	Cattle, Sheep, Swine, and Meats; Importation Prohibited in Certain Cases - Rinderpest and Food-and-mouth Disease	19 U.S.C. 1306	
	Importation of Milk and Cream	21 U.S.C. 141-149	
	Chapter 5 - Viruses, Serums, Toxins, etc.	21 U.S.C. 151-158	
	Improvement of Poultry, Poultry Products, and Hatcheries	7 U.S.C. 449	
	Anti-Hog-Cholera Serum and Hog-Cholera Virus Act	7 U.S.C. 851-855	
	The Swine Health Protection Act	7 U.S.C. 3801-3812	
	The Twenty-Eight Hour Law	45 U.S.C. 71-74	
	Export Animal Accommodation Act, as amended	46 U.S.C. 466a-466b	
	The Purebred Animal Duty-Free-entry Provision of Tariff Act of June 17, 1930, as amended	19 U.S.C. 1202, Part 1, Item 100.01	
	The Horse Protection Act	15 U.S.C. 1823-1831	
USDA	Federal Meat Inspection Act	19 U.S.C. 1306 21 U.S.C. 601 et seq.	This legislation relates to the Food Safety and Inspection Service requirements for specialty veterinary manpower.
	The Poultry Products Inspection Act, as amended	21 U.S.C. 451 et seq.	
USDA	Regulations Regarding Animals and Animal Products:		
	Subchapter A - Animal Welfare	Code of Federal Regula-Title 9, Parts 1-199	These regulations impact the Animal and Plant Health Inspection Service requirements for specialty veterinary manpower
	Subchapter B - Cooperative Control and Eradication of Livestock or Poultry Diseases		
	Subchapter C - Interstate Transportation of Animals (including Poultry) and Animal Products		

Agency	Legislation or Regulations	Citation	Summary of Selected Provisions
	Subchapter D - Exportation and Importation of Animals (including Poultry) and Animal Products		
	Subchapter E - Viruses, Serums, Toxins, and Analogous Products; Organisms and Vectors		
	Subchapter F - Poultry Improvement		
	Subchapter G - Animal Breeds		
	Subchapter H - Voluntary Inspection and Certification Service		

APPENDIX C

DEFINITIONS OF VETERINARY SPECIALTY DISCIPLINES

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Biochemistry--The chemistry of organisms and vital processes. The field underlies all veterinary, clinical, and basic life-science activities.

Clinical Specialties--Includes the specialties of anesthesiology, cardiology, clinical pathology, dentistry, internal medicine, neurology, oncology, ophthalmology, radiology, surgery, and theriogenology.

Environmental Health Sciences--A multidisciplinary applied field that has as its goals the identification of environmental health hazards and the protection of humans and animals from these hazards. Hazards include physical, chemical, and biologic substances. Techniques include monitoring, surveillance, and epidemiologic studies.

Epidemiology and Preventive Medicine--The field of study of the various factors that determine the frequencies and distributions of diseases and methods for their control and prevention.

Ethology--The scientific study of animal behavior, particularly in the natural state, and of the evolution of behavior and its biologic significance.

Genetics--The study of heredity. The science of genetics includes basic animal genetics, cytogenetics, plasmid biology, and applied specialties, such as the genetic effects of selection, genetic alteration of animal germinal or somatic cells, cloning, and the production and testing of genetically engineered products of plasmid biology.

Immunobiology--The study of animal responses to foreign substances. This includes humoral antibody-mediated immunity, cell-mediated immunity, and allergic and autoimmune responses to infectious and noninfectious materials. In particular, veterinarians are concerned with immunization of animals against infections, with basic studies of the immune response, and with immunologic mechanisms in animals as models for the study of human disease.

Laboratory-Animal Science and Support--The knowledge embodied in the supply, care, and use of laboratory animals in teaching, research, and animal testing. Includes anatomy, pathology, microbiology, parasitology, physiology, genetics, behavior, nutrition, and reproductive biology, as applied to the animals used. In a biomedical-research setting, it is usually the laboratory-animal veterinarian who provides the vital link between the laboratory-animal resources and the research scientists.

Microbiology--The science of microscopic organisms, including bacteria, fungi, viruses, rickettsiae, and mycoplasmas. Veterinary microbiology concerns itself primarily with pathogenic microorganisms and more particularly with the interaction of organisms and animals.

Molecular Biology--The science of the interaction of molecules in or derived from living systems. This science underlies and pervades the entire field of health and disease. Virtually all activities of veterinarians use the principles of molecular biology.

Neuroscience--The branch of medical science that deals with the nervous system. Subjects emphasized by veterinarians include characterization of the mechanisms of neural transduction, synaptic pharmacology and toxicology, and central nervous system control of physiologic processes and behavior. Veterinarians also contribute to the study of neural plasticity; of development, regeneration, and recovery of function; and of the mechanisms and control of neurologic disease.

Nutrition--The study of the assimilation and utilization of foods. Includes the identification and study of interactions between nutrition and other determinants of disease, research on wholesomeness of alternative sources of nutrients, and relationships among food-processing methods, nutritional quality, and disease.

Parasitology--The study of single-cell and multicell animal parasites of animals and man. Veterinary parasitology is concerned with parasites of animals and includes parasite-host interactions.

Pathology--The study of the structural and functional changes in tissues and organs of animals that cause or are caused by disease. Includes alterations in biochemical and physiologic mechanisms.

Pharmacology--The study of drugs in all their aspects. Veterinary pharmacology is concerned especially with the action of drugs in living systems.

Physiology--The science of the functions of living organisms and their parts. Veterinary physiology deals with these functions in domestic livestock, laboratory animals, and wild animals, and aims to increase animal health and productivity. Study of the physiology of animals as models of human disease is an important part of veterinary physiology.

Reproductive Biology--The study of the production of offspring. The fields of fertility control and augmentation are included. Artificial insemination, synchronization of estrus, endocrine therapy, spermatozoan and ovum genetic engineering, and ovum and embryo transplantation are some of the techniques commonly used.

Toxicology--The science that deals with harmful chemicals in foods and the environment. Veterinary toxicology involves all aspects of the general science, including the development of animal models for monitoring environmental hazards.

APPENDIX D

METHODS OF GENERATING TABLES 9-1 and 9-2 AND SOURCES OF INFORMATION

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TABLE 9-1

Table 9-1 reflects the best available information on the use of veterinarians not in private practice 1981. That no single source and even no small number of sources could be used to provide these figures is significant, but takes on greater importance when there is a need to project future demand. Time-series data are essential to the development of a predictive model. Such data are generally unavailable for veterinarians not in private practice.

Specific data sources for each line of the table follow:

A. Academic Institutions

1. Departments of agriculture, veterinary science, and animal science and related departments exclusive of schools and colleges of veterinary medicine--The 287 veterinarians employed in these departments were identified through personal contacts with each school throughout the country. No single source could be identified for this information. Reliable time-series data were unavailable.

2. Schools of Dentistry--The Association of American Dental Schools provided the Committee with this figure. Time-series data were unavailable.

3. Schools of Medicine--The figure for 1981 was derived by examination of each of the current medical-school catalogs to identify faculty and support staff holding veterinary degrees. The resulting rosters of veterinarians were then mailed to the schools for confirmation. Telephone followup was required in a number of instances to clarify ambiguities or obtain missing data. The resulting number, 406, is believed to be highly reliable for the 1980-1981 academic year. (Estimates of time-series data can be extrapolated from other sources, as explained.)

4. Schools of Osteopathic Medicine--The Association of American Schools of Osteopathic Medicine provided the figure in the table. Usable time-series data are not available--the figure for prior years has been zero.

5. Colleges of Pharmacy--The Association of American Colleges of Pharmacy provided the figure in the table. The total number of veterinarians who contribute to the programs of these colleges is notably larger (30), but the Association indicated that 27 of these veterinarians were employed by the colleges on a part-time basis only. To avoid counting them twice in the table, part-time staff were considered as being employed essentially full-time elsewhere. Time series data were not readily available.

6. Schools of Public Health--The Association of Schools of Public Health provided the figure in the table. Time-series data were not readily available.

7. Schools and Colleges of Veterinary Medicine--The Association of American Veterinary Medical Colleges (AAVMC) has generated an annual comparative data report for over a decade; it includes numbers of faculty, by school. Unfortunately, the report does not distinguish between faculty members with and without veterinary degrees.

In 1981, a total of 3,308 faculty members were listed for the American schools. However, personal contacts with the schools indicated that 77.6% of 2,252 faculty members holding the rank of assistant, associate, or full professor were veterinarians; the balance had other academic degrees. The 3,308 persons listed by the AAVMC include all the faculty plus those holding the rank of instructor, lecturer, or associate or other miscellaneous titles. Interns and residents are excluded, in that they are considered to be equivalent to graduate students or postdoctoral fellows, because they are still pursuing formal training.

Application of the 77.6% figure to the total for 1981 yields the figure given in the table, 2,567. Although those holding academic titles below the rank of assistant professor might include a greater or smaller percentage of veterinarians, reliable information on the true percentage is unavailable; that suggests that a reasonable estimate of the total number of veterinarians in this category can be obtained by the application of the 77.6% figure to the AAVMC totals.

Time-series data are available from the AAVMC as described above.

8. Schools with Programs in Veterinary Technology--Personal contact with representatives of a number of the schools provided the estimate in the table. Because only programs accredited by the AVMA were included in the tabulation, the number is probably an underestimate. The nonaccredited schools were excluded, because it had been demonstrated that they seldom employed veterinarians full-time. Among the accredited schools, few employed more than one full-time veterinarian, using instead the services of a number of persons on a part-time basis. Time-series data were not obtained.

B. Federal Government Agencies

Data on the various government agencies and their departments have been obtained from two major sources. The available data appear to be reliable. The primary source was the National Association of Federal Veterinarians. Individual data points obtained from specific agencies were used to verify information obtained from the Association, if reporting periods or data gaps would result in ambiguity. Gaps for some years were encountered, but time-series data were available.

The number of veterinarians employed by the federal government makes this an important category in the recognition of employment trends.

C. State Government Agencies

These data were obtained through personal communication with each of the officials in charge of animal-disease control, meat inspection, and veterinary public health in each state, as listed in the 1981 directory of the American Veterinary Medical Association. Time-series data were not readily available.

D. Industry

Two major segments of industry employ significant numbers of veterinarians: the poultry industry and the pharmaceutical and chemical industry. The estimate in the table for veterinarians employed by the poultry industry was obtained from the AVMA specialty classification after consultation with veterinarians in the field who felt that these figures were reliable. The estimate for the nonpoultry segment was obtained by personal communication with Gary R. Sampson, Secretary of the American Association of Industrial Veterinarians. His estimate was confirmed by extrapolation of data published in the A.D. Little report. Although a firm count is not available, this estimate appears to be within acceptable limits, with respect to the actual number. Time-series data can be obtained on the poultry pathologists, but are unavailable for the rest of the veterinarians employed in industry.

E. Nonprofit Institutions

1. Humane Societies--Although no formal records appear to exist to identify the precise number of veterinarians employed by the humane societies, Phyllis Wright at the Institute for the Study of Animal Problems, Humane Society of the United States, assured the Committee that 300 is a good estimate.

2. Primate Centers--The number of veterinarians employed at the primate centers has remained quite stable for several years at approximately 33, according to Leo Whitehair of the Animal Resources Program Branch of the Division of Research Resources, National Institutes of Health.

3. Zoos and Aquariums--The AVMA specialty classification was used as the source for this figure after consultation with a number of people in the specialty and cross-referencing of the resulting values with specialty association directories.

4. Private Diagnostic Laboratories--Personal communication with the person in charge of each private diagnostic laboratory, as listed in the Directory of Animal Disease Diagnostic Laboratories, provided the estimate given in the table. It is believed to be highly reliable for 1981, although no time-series data were obtainable.

TABLE 9-2

Table 9-2 summarizes time-series data gathered from all available sources for the 11-yr period beginning in 1970. Only categories for such data covering at least four consecutive years were included, to give a reasonable overview of employment trends in the non-private-practice segment of the profession. The apparent reliability of these data varies considerably, because there is no uniform collecting or reporting method.

The following descriptions for each employment category define the specific sources and methods used to compile the table:

A. Academic Institutions

1. Medicine--The AAMC maintains a count of all veterinarians employed as faculty members at American schools of medicine. It does not include veterinarians who are employed in nonfaculty roles, such as directors of laboratory-animal facilities. Therefore, the data tapes provide a portion of the total. Calvin Schwabe detailed this underrepresentation in his 1972 study and overcame it by personal contact with each school for a total count. A similar approach was used for the 1981 data. Comparison of the number obtained by Schwabe with that provided by the AAMC indicated that the total number of veterinarians employed at the schools of medicine in 1972 was 67% higher than the number listed in the faculty roster. No complete count exists for the years between 1972 and 1981, so an estimated time series was generated by applying the 1972 ratio to the faculty-roster values provided by the AAMC for the intervening years. Although this approach

would not be expected to yield a highly reliable figure for any given year, it does provide trend estimates that can be compared with the firm figure obtained for 1981 by examination of the various school catalogs and verification through direct contact. The estimate for 1981 would be 460 in contrast with the 406 derived from the schools. This extent of disagreement appears to be acceptable, given the methods used. Clearly, the ratio of 1 to 1.67 for faculty vs. total veterinarians employed was reasonably constant for the years involved.

2. Veterinary Medicine--As was the case for the schools of medicine, complete data were unavailable for veterinary schools over these years. The AAVMC collects extensive data on the faculties of the veterinary schools, but does not distinguish between members with and without veterinary degrees. To determine what proportion of all faculty members are veterinarians, each of the schools was contacted for the total number of faculty members and the number with veterinary degrees. For 1981, 77.6% of all veterinary-school faculty members were veterinarians in the professional ranks. This proportion was applied to the annual numbers of total faculty members reported by the AAVMC to obtain the figures used in Table 9-2, as explained above for Table 9-1. As with the medical schools, these time-series figures represent only reasonable estimates. Collectively, the two categories of academic institutions employ close to 3,000 veterinarians--an indication of the importance of collecting reliable numbers to predict future needs.

B. Federal Government Agencies

Time-series data on this large employer are generally available through the offices of the National Association of Federal Veterinarians. Total employment numbers were readily available for all government branches and for the USDA for most years. In addition, specific figures for FDA, NIH, EPA, and several others could be extracted. Changes in reporting procedures prevented the identification of time-series data in a number of agencies. In general, time-series data appear to be the most reliable.

C. Industry

The time-series figures for avian pathologists in industry appear to be reasonably accurate, although precise reporting does not exist. The AVMA specialty codes yielded values in close agreement with those offered by knowledgeable workers in this field. Hence, the AVMA figures were used directly.

D. Nonprofit Institutions

The directories of the specialty groups that include veterinarians at zoos and aquariums were cross-checked to estimate the validity of the figures derived from the AVMA specialty classifications for this time series. Although no single source currently exists for enumerating these veterinarians, the figures derived appear to be quite close. Veterinarians who are part-time consultants at zoos and aquariums, but who derive their principal income from other sources, have been excluded from this tabulation.

APPENDIX E

COLLECTIVE DATA ON SOURCES OF VETERINARY EMPLOYMENT

Table E-1	Colleges and Schools of Veterinary Medicine
Table E-2	Colleges and Schools of Medicine
Table E-3	State Universities and Colleges
Table E-4	State Animal Disease Control
Table E-5	State Meat Inspection
Table E-6	State Public Health Veterinarians

TABLE E-1

Colleges and Schools of Veterinary Medicine, Fall 1981[a]

State	School	No. Faculty Veterinarians (Total No. Faculty Members)
Alabama	Auburn University Tuskegee Institute	95 (110) 36 (44)
California	University of California, Davis	88 (118)
Colorado	Colorado State University, Ft. Collins	75 (152)
Florida	University of Florida, Gainesville	79 (100)
Georgia	University of Georgia, Athens	81 (112)
Illinois	University of Illinois, Urbana	72 (92)
Indiana	Purdue University, Lafayette	67 (79)
Iowa	Iowa State University, Ames	104 (122)
Kansas	Kansas State University, Manhattan	52 (78)
Louisiana	Louisiana State University, Baton Rouge	77 (89)
Massachusetts	Tufts University	35 (72)
Michigan	Michigan State University, East Lansing	78 (106)
Minnesota	University of Minnesota, St. Paul	82 (102)
Mississippi	Mississippi State University	37 (46)
Missouri	University of Missouri, Columbia	75 (94)
New York	Cornell University	88 (105)
North Carolina	North Carolina State University, Raleigh	29 (43)
Ohio	Ohio State University, Columbus	85 (96)
Oklahoma	Oklahoma State University, Stillwater	55 (68)
Oregon	Oregon State University, Corvallis	22 (27)
Pennsylvania	University of Pennsylvania, Philadelphia	74 (109)
Tennessee	University of Tennessee, Knoxville	53 (58)
Texas	Texas A&M University, College Station	90 (112)
Virginia	Virginia-Maryland Regional College of Veterinary Medicine	42 (51)
Washington	Washington State University, Pullman	66 (89)
	Total	1,737 (2,274)

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[a] Data obtained from individual veterinary schools by mail.

TABLE E-2

Colleges and Schools of Medicine, Academic Year 1980-1981[a]

State	School	No. Faculty Veterinarians
Alabama	University of Alabama School of Medicine	11
	University of South Alabama College of Medicine	1
Arizona	University of Arizona College of Medicine	5
Arkansas	University of Arkansas College of Medicine	4
California	University of California, Davis, School of Medicine	1
	University of California, Irvine, California College of Medicine	1
	University of California, Los Angeles, School of Medicine	5
	University of California, San Diego, School of Medicine	3
	University of California, San Francisco, School of Medicine	4
	Loma Linda University School of Medicine	1
	University of Southern California School of Medicine	7
	Stanford University School of Medicine	0
Colorado	University of Colorado School of Medicine	2
Connecticut	University of Connecticut School of Medicine	1
	Yale University School of Medicine	9
District of Columbia	Georgetown University School of Medicine	1
	George Washington University School of Medicine and Health Sciences	1
	Howard University College of Medicine	7
Florida	University of Florida College of Medicine (including FSU-FAMU program)	6
	University of Miami School of Medicine	0
	University of South Florida College of Medicine	2
Georgia	Emory University School of Medicine	4
	Medical College of Georgia School of Medicine	3
	School of Medicine at Morehouse College	1
Hawaii	University of Hawaii John A. Burns School of Medicine	1

State	School	No. of Faculty Veterinarians
Illinois	University of Chicago/The Pritzker School of Medicine	1
	University of Health Sciences/The Chicago Medical School	0
	University of Illinois College of Medicine	9
	Loyola University of Chicago Stritch School of Medicine	2
	Northwestern University Medical School	1
	Rush Medical College of Rush University	7
	Southern Illinois University School of Medicine	2
Indiana	Indiana University School of Medicine	1
Iowa	University of Iowa College of Medicine	4
Kansas	University of Kansas School of Medicine	1
Kentucky	University of Kentucky College of Medicine	2
	University of Louisville School of Medicine	2
Louisiana	Louisiana State University School of Medicine in New Orleans	5
	Louisiana State University School of Medicine in Shreveport	0
	Tulane University School of Medicine	1
Maryland	Johns Hopkins University School of Medicine	15
	University of Maryland School of Medicine	6
	Uniformed Services University of the Health Sciences School of Medicine	8
Massachusetts	Boston University School of Medicine	0
	Harvard Medical School	15
	University of Massachusetts Medical School	2
	Tufts University School of Medicine	12
Michigan	Michigan State University College of Human Medicine	23
	University of Michigan Medical School	3
	Wayne State University School of Medicine	2
Minnesota	Mayo Medical School	2
	University of Minnesota-Duluth School of Medicine	1
	University of Minnesota Medical School-Minneapolis	5
Mississippi	University of Mississippi School of Medicine	4

State	School	No. of Faculty Veterinarians
Missouri	University of Missouri-Columbia School of Medicine	2
	University of Missouri-Kansas City School of Medicine	1
	Saint Louis University School of Medicine	4
	Washington University School of Medicine	1
Nebraska	Creighton University School of Medicine	0
	University of Nebraska College of Medicine	0
Nevada	University of Nevada, Reno, School of Medicine	0
New Hampshire	Dartmouth Medical School	0
New Jersey	College of Medicine and Dentistry of New Jersey/New Jersey Medical School	1
	College of Medicine and Dentistry of New Jersey Rutgers Medical School	1
New Mexico	University of New Mexico School of Medicine	2
New York	Albany Medical College of Union University	1
	Albert Einstein College of Medicine of Yeshiva University	6
	Columbia University College of Physicians and Surgeons	1
	Cornell University Medical College	3
	Mount Sinai School of Medicine of the City University of New York	3
	New York Medical College	4
	New York University School of Medicine	4
	University of Rochester School of Medicine and Dentistry	6
	State University of New York at Buffalo School of Medicine	4
	State University of New York Downstate Medical Center College of Medicine	5
	State University of New York at Stony Brook Health Sciences Center School of Medicine	2
	State University of New York Upstate Medical Center College of Medicine	1
North Carolina	Bowman Gray School of Medicine of Wake Forest University	9
	Duke University School of Medicine	2
	East Carolina University School of Medicine	1
	University of North Carolina School of Medicine	4

State	School	No. of Faculty Veterinarians
North Dakota	University of North Dakota School of Medicine	2
Ohio	Case Western Reserve University School of Medicine	4
	University of Cincinnati College of Medicine	8
	Medical College of Ohio at Toledo	3
	Northeastern Ohio Universities College of Medicine	2
	Ohio State University College of Medicine	1
	Wright State University School of Medicine	2
Oklahoma	Oral Roberts University School of Medicine	1
	University of Oklahoma College of Medicine	3
Oregon	University of Oregon School of Medicine	1
Pennsylvania	Hahnemann Medical College	5
	Jefferson Medical College of Thomas Jefferson University	2
	Medical College of Pennsylvania	1
	Pennsylvania State University College of Medicine	6
	University of Pennsylvania School of Medicine	4
	University of Pittsburgh School of Medicine	2
	Temple University School of Medicine	3
Rhode Island	Brown University Program in Medicine	2
South Carolina	Medical University of South Carolina College of Medicine	1
	University of South Carolina School of Medicine	1
South Dakota	University of South Dakota School of Medicine	1
Tennessee	East Tennessee State University College of Medicine	1
	Meharry Medical College School of Medicine	3
	University of Tennessee College of Medicine	4
	Vanderbilt University School of Medicine	1

State	School	No. of Faculty Veterinarians
Texas	Baylor College of Medicine	8
	Texas A&M University College of Medicine	0
	Texas Tech University School of Medicine	3
	University of Texas Southwestern Medical School at Dallas	10
	University of Texas Medical School at Galveston	3
	University of Texas Medical School at Houston	3
	University of Texas Medical School at San Antonio	4
Utah	University of Utah College of Medicine	6
Vermont	University of Vermont College of Medicine	1
Virginia	Eastern Virginia Medical School	1
	Virginia Commonwealth University Medical College of Virginia School of Medicine	2
	University of Virginia School of Medicine	4
Washington	University of Washington School of Medicine	5
West Virginia	Marshall University School of Medicine	1
	West Virginia University School of Medicine	2
Wisconsin	Medical College of Wisconsin	1
	University of Wisconsin Medical School	3
	Total	406

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[a] Data obtained by examining faculty list in medical-school catalogs for 1980-1981 academic year and confirming numbers of veterinarians by mail or telephone.

TABLE E-3

State University and College Departments of Agriculture, Veterinary Science, and Animal Science and Related Departments, 1981[a]

State	School and Department	No. Faculty Veterinarians
Alabama	Tuskegee Institute	
	Agricultural Sciences	1
	Cooperative Extension Service	1
Arizona	University of Arizona, Tucson	
	Veterinary Science	7
Arkansas	University of Arkansas, Fayetteville	
	Animal Sciences	6
California	California State University, Fresno	
	School of Agriculture	3
	University of California, Davis	
	Extension Service (Agr.)	1
Connecticut	University of Connecticut, Storrs	
	Northeastern Research Center for Wildlife Diseases	3
	Pathobiology	13
	Administration	1
Delaware	University of Delaware, Newark	
	Animal Science and Agricultural Biochemistry	3
	Substation (Georgetown)	1
Florida	University of Florida, Gainesville	
	Animal Science	1
Georgia	University of Georgia, Athens	
	Veterinary Medicine	5
	Poultry Disease Research Center	7
	Fort Valley State College, Fort Valley	
	Animal Science	2
Hawaii	University of Hawaii, Honolulu	
	Animal Sciences	2
Idaho	University of Idaho, Moscow	
	Veterinary Science	7
	Fishery Resources	1
Illinois	Southern Illinois University, Carbondale	
	Animal Industries	1
Kentucky	Murray State University, Hopkinsville	
	Veterinary Diagnostic and Research Center	4
	University of Kentucky, Lexington	
	Veterinary Science	11

State	School and Department	No. Faculty Veterinarians
Louisiana	McNeese State University, Lake Charles	
	Department of Agriculture	1
	Southern University & Agriculture & Mechanical College, Baton Rouge	
	Animal Science	1
Maine	University of Maine, Orono	
	Animal and Veterinary Sciences	2
Maryland	University of Maryland, College Park	
	Veterinary Science	13
Massachusetts	University of Massachusetts, Amherst	
	Veterinary and Animal Sciences	2
	Substation: Suburban Experiment Station - Waltham	1
Michigan	Michigan State University, East Lansing	
	Dairy Science	3
	Department of Agriculture, Laboratory Division	4
	Substation: Upper Peninsula Experiment Station	1
Missouri	Central Missouri State University	
	Department of Agriculture	1
	University of Missouri, Columbia	
	Biochemistry (Agr. and Med.)	1
	Veterinary Science	2
Montana	Montana State University, Bozeman	
	Veterinary Research Laboratory	5
Nebraska	University of Nebraska, Lincoln	
	Veterinary Science	13
	University of Nebraska, North Platte	
	Veterinary Science Laboratory	1
Nevada	University of Nevada, Reno	
	Veterinary Medicine	4
New Hampshire	University of New Hampshire, Durham	
	Animal Sciences	4
New Jersey	Rutgers, State University of New Jersey	
	Animal Science	4
	Substation: Poultry Pathology Laboratory	1
New York	Cornell University, Ithaca	
	Animal Science	1
North Carolina	North Carolina State University, Raleigh	
	Animal Science	1
	Poultry Science	1
	North Carolina Agricultural and Technical State University, Greensboro	
	Animal Science	2

State	School and Department	No. Faculty Veterinarians
North Dakota	North Dakota State University of Agriculture and Applied Science, State U. Station, Fargo	
	Veterinary Science	14
Ohio	Ohio State University, Columbus	
	Animal Science	3
	Dairy Science	1
	Poultry Science	3
	Ohio Agricultural Research & Development Center, Wooster	
	Animal Science	2
	Dairy Science	1
	Poultry Science	3
	Veterinary Science	15
Oklahoma	Oklahoma State University, Stillwater	
	Division of Agriculture	7
Oregon	Oregon State University, Corvallis	
	Chemistry (Agr.)	2
	Laboratory Animal Resources	1
Pennsylvania	Pennsylvania State University, University Park	
	Veterinary Science	13
Rhode Island	University of Rhode Island, Kingston	
	Department of Animal Pathology	3
South Carolina	Clemson University, Clemson	
	Animal Science	1
	Dairy Science	1
	Food Science	1
	Livestock-Poultry Health Div. - Elgin	3
	Poultry Science	1
South Dakota	South Dakota State University, Brookings	
	Animal Science	1
	Veterinary Science	8
Tennessee	University of Tennessee, Knoxville	
	Animal Science	1
Texas	Southwest Texas State University	
	Animal Science	1
	Texas A&M University, College Station	
	Research Center - Amarillo	1
	Field Station: Center Poultry Disease Laboratory	1
	Prairie View A&M University, Prairie View	
	Agriculture	1
	Texas Tech University	
	College of Agriculture	1

State	School and Department	No. Faculty Veterinarians
Utah	Utah State University of Agriculture & Applied Science, Logan Animal, Dairy & Veterinary Sciences	11
Vermont	University of Vermont, Burlington Animal Pathology	4
Virginia	Virginia Polytechnic Institute & State University, Blacksburg Extension Service Program	1
	Virginia State University, Petersburg Animal Science	6
West Virginia	West Virginia University, Morgantown Division of Animal & Veterinary Science	4
Wisconsin	University of Wisconsin, Madison Veterinary Science	17
Wyoming	University of Wyoming, Laramie Div. of Microbiology & Veterinary Medicine	4
	Total	287

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[a] Data obtained from individual institutions by mail or telephone.

TABLE E-4

State Animal-Disease Control Offices, 1971 and 1981[a]

State	No. Staff Veterinarians 1971	No. Staff Veterinarians 1981
Alabama	11	13
Alaska	2	2
Arizona	2	2
Arkansas	7	7
California	55	40
Colorado	3	3
Connecticut	2	4
Delaware	1	1
Florida	19	19
Georgia	6	6
Hawaii	11	11
Idaho	10	4
Illinois	20	19
Indiana	10	12
Iowa	10	11
Kansas	3	3
Kentucky	3	3
Louisiana	13	13
Maine	5	5
Maryland	11	11
Massachusetts	6	6
Michigan	20	12
Minnesota	18	13
Mississippi	5	5
Missouri	9	10
Montana	8	10
Nebraska	4	8
Nevada	4	5
New Hampshire	5	3
New Jersey	8	8
New Mexico	1	1
New York	27	17
North Carolina	27	31
North Dakota	2	2
Ohio	18	16

State	1971	1981
Oklahoma	2	4
Oregon	8	7
Pennsylvania	25	25
Rhode Island	2	1
South Carolina	10	10
South Dakota	2	2
Tennessee	4	6
Texas	17	17
Utah	1	1
Vermont	1	0
Virginia	28	28
Washington	6	7
West Virginia	4	4
Wisconsin	23	25
Wyoming	2	2
Total	501	475

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[a] Data obtained from animal-disease control office in each state.

TABLE E-5

State Meat-Inspection Offices, 1971 and 1981[a]

State	No. Staff Veterinarians 1971	No. Staff Veterinarians 1981
Alabama	4	3
Alaska	2	2
Arizona	3	2
Arkansas	7	0
California	53	9
Colorado	1	0
Delaware	4	1
Florida	29	29
Georgia	6	6
Hawaii	6	4
Idaho	0	0
Illinois	15	6
Indiana	21	21
Iowa	8	7
Kansas	5	5
Louisiana	7	7
Maine	0	0
Maryland	8	4
Massachusetts	ND	0
Michigan	24	0
Minnesota	0	0
Mississippi	6	6
Missouri	ND	0
Nebraska	0	0
New Mexico	0	0
New York	ND	1
North Carolina	12	13
Ohio	22	14
Oklahoma	5	5
Rhode Island	0	0
South Carolina	6	6
South Dakota	3	2
Texas	17	17
Utah	1	1
Vermont	2	1

State	1971	1981
Virginia	8	8
Washington	ND	2
West Virginia	4	4
Wisconsin	13	17
Wyoming	ND	2
Total	302	205

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[a] Data obtained from meat-inspection office in each state. ND = no data given.

TABLE E-6

State Public Health Veterinarians

	No. Veterinarians	
State	1971	1981
Alabama	1	1
Arizona	2	2
Arkansas	1	1
California	4	4
Colorado	1	1
Florida	6	6
Idaho	1	1
Illinois	2	2
Indiana	1	1
Iowa	2	1
Kansas	1	1
Kentucky	2	2
Louisiana	1	1
Maryland	1	1
Massachusetts	2	2
Michigan	5	5
Missouri	2	2
New Jersey	0	0
New Mexico	0	1
New York	7	7
North Carolina	1	1
Ohio	1	1
Oregon	8	7
Pennsylvania	1	1
South Carolina	0	1
Tennessee	0	0
Texas	10	10
Utah	1	1
Vermont	1	1
Total	65	65

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[a] Data obtained from public-health veterinarian office in each state.

APPENDIX F

PROJECTED SURVEY OF VETERINARIANS IN BIOMEDICAL RESEARCH, EDUCATION, AND INDUSTRY

PROJECTED SURVEY OF VETERINARIANS IN BIOMEDICAL RESEARCH, EDUCATION, AND INDUSTRY

1. What types of institutions employ veterinarians (other than veterinary medical treatment clinics)? How many of these institutions conduct biomedical research, and at what level (indicate biomedical research budget)?

2. How many veterinarians are employed in full-time equivalents (FTE) in the above institutions? Indicate the number of veterinarians by FTE in teaching, research, administration, and support staff, and also show the total numbers of FTEs employed in the above categories. This data can be requested retroactively to show the current trend. Projected numbers can be requested for the future based on assumptions derived from legislative and regulatory directives.

3. In the listing of specialty disciplines (as in Appendix C) indicate the number of veterinarians by FTE functioning in these disciplines. If data is available, please indicate the number of veterinarians employed as above in 1970 and 1975. Please project the number of veterinarians that will be required in these specialties in 1985 and 1990.

4. For training institutions only. Please indicate the types of specialty training offered, including length of time of programs, degree of certification granted, discipline, and the number of trainees in each program in 1975 and currently. Please indicate the number of M.S. and Ph.D. degrees to be awarded in the above disciplines in 1983, 84, and 85.

5. Please identify and rate the factors which are likely to limit the number of veterinary postdoctorals enrolled in your program currently, and in 1985.

This projected survey is shown to indicate some of the questions the Committee saw as potentially valuable during its study. Any survey actually used would have to be modified in terms of the specific purpose and time period for the survey.

APPENDIX G

VETERINARY SPECIALTY MANPOWER NEEDS PROJECTED BY FEDERAL AGENCIES FOR 1985 AND 1990

- Department of Agriculture
  - Agricultural Research Service
  - Animal and Plant Health Inspection Service
  - Food Safety and Inspection Service
- Department of Defense
- Department of the Interior
- Environmental Protection Agency
- Food and Drug Administration

United States
Department of
Agriculture

Science and
Education
Administration

Agricultural Research
North Central Region
National Animal
Disease Center

P.O. Box 70
Ames, Iowa
50010

DEPARTMENT OF AGRICULTURE - AGRICULTURAL RESEARCH SERVICE

April 2, 1981

SUBJECT: Recruitment and Retention of Veterinary Scientists and Toxicologists

TO: Clare Harris
Acting Associate Director

In his memo of January 14, 1981, on this subject, Dr. Ralph J. McCracken asked that a needs assessment study be undertaken to determine the current and future staffing needs for SEA veterinarians by specialization. Such a study was undertaken in February.

My efforts were fully coordinated with those of Dr. Donald Witzel to avoid duplication of data developed. I asked line and staff managers of 16 laboratories or programs (Attachment I) to complete a simple questionnaire specifying their onboard strength and projecting their realistic needs for veterinarians other than toxicologists through FY 90 without regard to personnel ceilings or funding limitations. The results of this survey are summarized (Attachment II). A table showing the strength and needs of each laboratory or program is also included (Attachment III).

Each program manager has a clear understanding of the scientific program demands, leadership requirements, team-staffing needs and attritional pressures relating to his program. Their needs projections are realistic. Specialization in this profession as well as in most others in research will continue and will intensify in the foreseeable future. Recruitment and retention of veterinary scientists and toxicologists is vital to the maintenance of the World leadership position of the SEA animal health program.

Please advise if we can be of further assistance to you on this important matter.

Phillip A. O'Berry

PHILLIP A. O'BERRY
Director

Attachments

cc:
E. L. Corley, PAC
T. B. Kinney, Jr., AR
W. I. Thomas, CR
M. R. Greenwood, Extension
M. D. Christensen, Personnel

ATTACHMENT I

USDA-ARS

1.	Dr. Phillip A. O'Berry National Animal Disease Center	Ames, Iowa
2.	Dr. Jerry J. Callis Plum Island Animal Disease Center	Greenport, N.Y.
3.	Dr. W. S. Bailey Regional Parasite Res. Laboratory	Auburn, Alabama
4.	Dr. C. W. Beard Southeast Poultry Research Laboratory	Athens, Georgia
5.	Dr. Harry Herlich Animal Parasitology Institute	Beltsville, Maryland
6.	Dr. Robert Oltjen Roman L. Hruska U.S. Meat Animal Research Center	Clay Center, Nebraska
7.	Dr. Earl J. Splitter SEA/CR	Washington, D.C.
8.	Dr. R. L. Witter Regional Poultry Research Laboratory	E. Lansing, Michigan
9.	Dr. H. G. Purchase NPS-LVS, SEA-AR	Beltsville, Maryland
10.	Dr. T. H. Blosser PPS, JPE, SEA	Beltsville, Maryland
11.	Dr. James W. Deaton South Central Poultry Res. Lab.	Mississippi State, Mississippi
12.	Dr. Donald E. Witzel Veterinary Toxicology and Entomology Research Laboratory	College Station, Texas
13.	Dr. Lynn James Poisonous Plants Laboratory	Logan, Utah
14.	Dr. John R. Gorham Animal Disease Research Unit	Pullman, Washington
15.	Dr. T. E. Walton Arthropod-borne Animal Dis. Res. Lab.	Denver, Colorado
16.	Dr. Dixon D. Hubbard SEA/Ext.	Washington, D.C.

USDA-ARS

ATTACHMENT 11

QUESTIONNAIRE ON STAFF NEEDS FOR VETERINARIANS

INSTRUCTIONS: Complete the following from your understanding of what the realistic needs are for veterinarians at your location or in your program without regard for personnel ceilings or funding limitations. Include in your projection veterinarians who may be leaving federal service and should be replaced.

Location - 16 SEA Locations or Programs

Respondent -

No. on Board - 81

Specialty		Additional Veterinarians Needed		
	FY 81	FY 82-85	FY 86-90	Remarks
Nonspecialized	7	3	2	12
Bacteriologist	2	4	1	7
Physiologist	1	2	1	4
Pathologist	7	3	4	14
Virologist	4	9	8	20
Immunologist	2	6	4	13
Parasitologist	4	2	2	8
TOTAL	27	29	22	80*

*Includes 1 Veterinary Entomologist and 1 Veterinary Epidemiologist

ATTACHMENT III

Program	Veterinarians on Board	Additional Veterinarians Needed FY 81							Additional Veterinarians Needed FY 82-85							Additional Veterinarians Needed FY 86-90							Total Additional Veterinarians Needed FY 81-90							Total
		N	B	Ph	Pa	V	I	P	N	B	Ph	Pa	V	I	P	N	B	Ph	Pa	V	I	P	N	B	Ph	Pa	V	I	P	
NADC	33		2	1	1	2			1	3			1			1		1		2			2	5	2	1	5			15
PIADC	20					2	1						5	3	2	1				5	2		1				12	6	2	21
Auburn	1							1			1	1									1	1			1	1		1	2	5
Athens	6									1				1										1				1		2
Beltsville	1*	1			1		1	1															1			1		1	1	4
MARC	1	1			1			1			1			1									1		1	1		1	1	5
CR & Ext.	1	2							1														3							3
East Lansing	4												1						1							1	1			2
NPS	4	1						1															1						1	2
PPS	0	1																					1							1
Miss. State	0				1																					1				1
Tex. A&M	2				1							1							2							4				4
Logan	1	1			1																		1			1				2
Pullman	3											1	1	1			1		1	1	1			1		2	2	2		7
Denver	4				1				1				1									1	1			1		1	1	6**
Total	81	7	2	1	7	4	2	4	3	4	2	3	9	6	2	2	1	1	4	8	4	2	12	7	4	14	20	13	8	80
					26							29							22											

*Kuttler will go to Pullman

**1 Entomologist, 1 Epidemiologist in addition to those shown

N = Nonspecialized
B = Bacteriologist
Ph = Physiologist
Pa = Pathologist

V = Virologist
I = Immunologist
P = Parasitologist

United States
Department of
Agriculture

Animal and
Plant Health
Inspection Service

Federal Bldg.
Hyattsville, MD 20782

DEPARTMENT OF AGRICULTURE - ANIMAL AND PLANT HEALTH INSPECTION SERVICE

FEB 26 1981

Dr. W. Jean Dodds, Chairman
Committee on Veterinary Medical Science
National Research Council
Assembly of Life Sciences
2101 Constitution Avenue
Washington, D.C. 20418

Dear Dr. Dodds:

Dr. Harry C. Mussman has asked that I respond to your November 12, 1980, request for information on veterinary medical science manpower needs in the Animal and Plant Health Inspection Service, U.S. Department of Agriculture.

Following is our response to your questionnaire:

Question I.A.

Legislation that impacts Animal and Plant Health Inspection Service requirements for specialty veterinary manpower is contained in Chapters 4 and 5, United States Code Annotated (U.S.C.), Title 21, Food and Drugs sections 1 to 800; Title 19, U.S.C. section 1306; the Improvement of Poultry, Poultry Products, and Hatcheries, (7 U.S.C. section 449); the Anti-Hog-Cholera Serum and Hog-Cholera Virus Act, (7 U.S.C. sections 851 - 855); the Swine Health Protection Act, (7 U.S.C. sections 3801 - 3812); the Twenty-Eight Hour Law, (45 U.S.C. sections 71 - 74); the Export Animal Accommodation Act, as amended, (46 U.S.C. sections 466a - 466b); the Purebred animal duty-free-entry provision of Tariff Act of June 17, 1930, as amended, (19 U.S.C. 1202, Part 1, Item 100.01); the Animal Welfare Act, as amended, (7 U.S.C. sections 2131 - 2156); and the Horse Protection Act, (15 U.S.C. sections 1823 - 1831), as follows:

Importation of Cattle and Quarantine
(21 U.S.C. sections 101 - 105)

Prevention of Introduction and Spread of Contagion
(21 U.S.C. sections 111 - 135b)

Cattle, sheep, swine, and meats; importation prohibited in certain cases - Rinderpest and foot-and-mouth disease
(19 U.S.C. section 1306)

Importation of Milk and Cream
(21 U.S.C. sections 141 - 149)

Chapter 5 - Viruses, Serums, Toxins, Etc.
(21 U.S.C. sections 151 - 158)

Improvement of Poultry, Poultry Products, and Hatcheries
(7 U.S.C. section 449)

Anti-Hog-Cholera Serum and Hog-Cholera Virus Act
(7 U.S.C. sections 851 - 855)

The Swine Health Protection Act
(7 U.S.C. sections 3801 - 3812)

The Twenty-Eight Hour Law
(45 U.S.C. sections 71 - 74)

Export Animal Accommodation Act, as amended
(46 U.S.C. sections 466a - 466b)

The Purebred animal duty-free-entry provision of Tariff Act of June 17, 1930, as amended
(19 U.S.C. 1202, Part 1, Item 100.01)

The Animal Welfare Act, as amended
(7 U.S.C. sections 2131 - 2156)

The Horse Protection Act
(15 U.S.C. sections 1823 - 1831)

Regulations that impact Animal and Plant Health Inspection Service requirements for specialty veterinary manpower are contained in the Code of Federal Regulations, Title 9, Animals and Animal Products, Parts 1 to 199, as follows:

Subchapter A - Animal Welfare

Subchapter B - Cooperative Control and Eradication of Livestock or Poultry Diseases

Subchapter C - Interstate Transportation of Animals (Including Poultry) and Animal Products

Subchapter D - Exportation and Importation of Animals (Including Poultry) and Animal Products

Subchapter E - Viruses, Serums, Toxins, and Analogous Products; Organisms and Vectors

Subchapter F - Poultry Improvement

Subchapter G - Animal Breeds

Subchapter H - Voluntary Inspection and Certification Service

Question I.B.

We do not anticipate any new legislation and/or regulations to be passed and/or implemented during fiscal 1981.

Question II.A. - Present Staffing Levels

Specialty	Number Employed	Educational Level	Grade Level
Animal Care	3	DVM - 3	GS-14 (1) GS-13 (1) GS-12 (1)
Brucellosis Epidemiology	1	MS - 1	GS-14 (1)
Brucellosis Eradication	4	DVM - 4	GS-15 (1) GS-14 (3)
Epidemiology (General)	544	PhD. - 4 MS - 84 DVM - 456	SES (2) GS-15 (7) GS-14 (49) GS-13 (70) GS-12 (358) GS-11 (35) GS-09 (23)
Laboratory Animal Medicine	1	PhD. - 1	GM-13 (1)
Management	5	LLD. - 1 PhD. - 1 DVM - 3	SES (1) GM-14 (4)
Microbiology	29	PhD. - 15 MS - 14	GS-15 (6) GS-14 (11) GS-13 (8) GS-12 (3) GS-11 (1)
Miscellaneous Diseases	1	DVM - 1	GS-13 (1)
Parasitology	1	PhD. - 1	GM-14 (1)
Pathology	12	PhD. - 10 MS - 1 DVM - 1	GM-15 (2) GM-14 (3) GM-13 (2) GS-12 (3) GS-11 (1) GS-09 (1)

Poultry Disease	1	DVM - 1	GS-14 (1)
Swine Brucellosis and Tuberculosis	2	DVM - 2	GS-14 (2)
Toxicology	2	PhD. - 2	GS-14 (1) GS-12 (1)
Tuberculosis Epidemiology	1	DVM - 1	GS-14 (1)
Tuberculosis Eradication	1	DVM - 1	GS-14 (1)

Question II.B. - Projected In-Ceiling Needs

1985

Specialty	Number Employed	Educational Level	Grade Level
Administration	1	MS - 1	GS-15 (1)
Animal Science	1	MS - 1	GS-13 (1)
Exotic Animals	1	MS - 1	GS-14 (1)
Laboratory Animals	1	MS - 1	GS-14 (1)
Miscellaneous Diseases	2	MS - 2	GS-14 (2)
Pathology	1	MS - 1	GS-14 (1)
Physiology	1	MS - 1	GS-14 (1)

1990

Administration	2	MS - 2	GS-15 (1) GS-14 (1)
Animal Science	2	MS - 2	GS-14 (2)
Bird Specialist	1	MS - 1	GS-14 (1)
Exotic Animals	1	MS - 1	GS-14 (1)
Laboratory Animals	1	MS - 1	GS-14 (1)
Pathology	1	MS - 1	GS-14 (1)
Physiology	1	MS - 1	GS-14 (1)

Question II.C. - Desired Staffing Levels

Our desired staffing levels for 1985 and 1990 are the sum total of II.A. plus II.B.

Question II.D. - Justification

Manpower projections are based on informal discussions.

Question III - Impact

A. Industry

1. Current (a) Attending veterinarians for 1,100 research establishments. (b) Practicing veterinarians to service and advise 4,000 animal dealers and 1,200 animal exhibitors.

2. By 1985, numbers of types of establishments covered by the Animal Welfare Act are expected to increase to the following levels: 1,600 research establishments, 5,000 dealers, and 1,500 exhibitors. In addition, coverage of certain farm animal operations will increase demand on farm animal practice.

3. By 1990:
 2,000 research establishments
 10,000 dealers
 2,000 exhibitors

Additional coverage of bird facilities, pet shops, guard dog facilities, public animal shelters, intensive poultry, hog and calf operations, truck transportation of livestock, and animal fighting ventures.

B. State

No important impact projected.

C. Educational Institutions

No important impact projected.

Question IV. - Newly Expanding Roles

A. 1. Need for more rigidly controlled animal tests has contributed to the need for more specialized expertise in laboratory animal medicine.

2. New advances in immunological techniques have contributed to the need for additional specialists in immunology.

3. Increased importance of toxic disease has contributed to the need for specialties in pathotoxicology.

B. None.

Question V. - Constraints

The major constraint is in competing salary-wise with industry and academia in the initial hiring of previously trained specialists. As a result, most veterinarians are hired by the National Veterinary Services Laboratories (NVSL) before they obtain specialty training and then are provided training on a part-time basis at government expense. This is time consuming and, in the long run, an inefficient way to obtain the expertise needed in a specialized facility such as NVSL.

These replies were developed in consultation with Chief Staff Officers, Regional Directors, and other key management officials within Veterinary Services, Animal and Plant Health Inspection Service.

I trust the responses provided to your questionnaire will assist you in your study entitled "The Implication of Legislation and Regulations on the Need for Veterinary Manpower." If I can provide additional assistance, please let me know.

Sincerely,

George S. Robertson

George S. Robertson
Director
Human Resources Division

United States
Department of
Agriculture

Food Safety
and Inspection
Service

Washington, D.C.
20250

Building 318 C, ARC East
Beltsville, MD 20705

DEPARTMENT OF AGRICULTURE - FOOD SAFETY AND INSPECTION SERVICE

November 3, 1982

June Ewing
National Academy of Sciences
2101 Constitution Ave., N. W.
Washington, D. C. 20418

Dear Ms. Ewing:

In response to your telephoned request for information:

The Science unit of the Food Safety Inspection Service employs 19 graduate veterinarians in the following specialities.

- Veterinary Pathologist - 10
  - Eight have masters degrees in pathology
    - One of these is ACVP certified
    - One masters degree in parasitology
    - One Ph.D in poultry pathology
- Veterinary Immunologist - 3
    - One post doctorate masters degree in biomedical engineering
    - One masters degree in pharmacology and Ph.D in physiological chemistry
    - One masters degree in parasitology
- Veterinary Epidemiologist - 5
    - One Ph.D in microbiology
    - One Ph.D in virology
    - Two masters of public health
- Scientific Manager - 1
- Veterinary Toxicologist - 2

I hope this information will be useful to you in completing your project.

Yours truly,

Jack Leighty

Jack C. Leighty, D.V.M.
Director
Pathology & Epidemiology Division

United States
Department of
Agriculture

Food Safety
and Inspection
Service

Washington, D.C.
20250

NOV 16 1982

Dr. W. Jean Dodds, Chairman
Commission on Veterinary Medical Science
National Research Center
2101 Constitution Avenue
Washington, D.C. 20418

Dear. Dr. Dodds:

Listed below is the breakdown of the Veterinarian occupations in Science, Food Safety and Inspection Service, United States Department of Agriculture.

	Number
Administrative	6
Pathology	10
Epidemiology	5
Serology	2
Residue	1
Total	24

Sincerely,

John E Spaulding

John E. Spaulding, Director
Residue Evaluation and Planning Division

DEPARTMENT OF DEFENSE

DATA REQUESTED REGARDING THE IMPLICATIONS OF LEGISLATION AND REGULATIONS ON THE NEED FOR VETERINARY MANPOWER

I Legislation/regulations impacting upon requirements for specialty-trained veterinarians:

- A. Animal Welfare Act - USDA
- B. Good Laboratory Practices Regulations - FDA
- C. Toxic Substances Control Act - EPA
- D. Federal Insecticide, Fungicide, and Rodenticide Act - EPA
- E. Consumer Products Safety Act - CPSC
- F. Organization for Economic Cooperation and Development - USA signatory with 23 other countries

II Staffing Levels - Specialty-trained veterinarians

- A. Present staffing
  - 1. By specialty
    See Table 1
  - 2. Educational Level
    See Table 2
  - 3. Rank/G-S Level
    See Table 3
- B. In-ceiling needs for 1985 and 1990
  - 1. By specialty - 1985
    See Table 4
  - 2. Educational Level - 1985
    See Table 5
  - 3. Rank/G-S Level - 1985
    See Table 6
  - 4. By specialty - 1990
    See Table 7
  - 5. Educational Level - 1990
    See Table 8
  - 6. Rank/G-S Level - 1990
    See Table 9
- C. Desired staffing for 1985 and 1990
  - 1. By specialty - 1985
    See Table 10
  - 2. Educational Level - 1985
    See Table 11
  - 3. Rank/G-S Level - 1985
    See Table 12
  - 4. By specialty - 1990
    See Table 13
  - 5. Educational Level - 1990
    See Table 14
  - 6. Rank/G-S Level - 1990
    See Table 15

D. Justification for Above Data

1. Military manpower surveys of research and field facilities have identified both authorized and required manpower levels addressing each specialty area. The DOD currently has requirements approximately 16% above that authorized. The allocation of authorized slots is governed by manpower ceilings imposed upon DOD/Individual Services/Medical Departments, etc.

2. The present staffing levels indicate those specialities authorized throughout the services. The R&D positions reflect a universal requirement for specialty-training, either by achievement of board certification or graduate degree. The public health-oriented (public health and food technology) positions reflect present board certified/graduate-level requirements within the authorized field strength.

3. The 1985 and 1990 in-ceiling needs are based upon current DOD guidance of approximately 2% increase for 1985 and 2% above that for 1990.

4. The desired staffing level forecasts were generated by applying the current veterinary shortfall within the USAMRDC (110 required; 95 authorized) to the remainder of DOD specialized training-required positions. It should be noted that there are currently only 84 individuals available to fill the 95 authorized positions. In addition, a potentially more realistic forecast reflects a 2% growth per year between now and 1990 in lieu of the 2% per 5-years growth under current manpower-constraint guidance.

5. As DOD is currently under Congressional mandate to: (a) abolish the USAF Veterinary Corps (accomplished March 1980); (b) civilianize 102 R&D positions by the end of FY 83; (c) reduce uniformed end strength to 339 officers by the end of FY 83; the DOD veterinary manpower needs are presented without specific regard to military or civilian status. The Surgeon General of the Army and the other Services have gone on record stating the improbabilities, impracticalities, and jeopardy to DOD R&D programs of of civilianizing 54% of its veterinary R&D positions.

6. As noted above, the uniformed end strength of the Army Veterinary Corps is to be 339 officers by the end of FY 83. There are thus 162 military positions not requiring civilian-specialty training beyond the DVM level. Those positions represent primarily new officers on active duty and those on extended duty and fulfilling duty training requirements within DOD/government programs.

7. Military requirements and their priorities undergo both short- and long-term fluctuations, impacting upon specific demand for specialized professionals. Thus, the forecast numbers and spread throughout the specialty areas are current estimates based upon known or likely mission areas of biomedical research within DOD. These data should not be construed as official DOD projections but rather as best estimates formulated for the purposes of this contract effort.

III N/A for DOD

IV Newly expanding roles for specialty-trained veterinarians

A.	1.	Toxicology	13
	2.	Physiology	21
	3.	Environmental Sciences	3
	4.	Marine mammals	0
	5.	Psychology/behavioral sciences	1
	6.	Research management	13
B.	1.	Toxicology	2
	2.	Physiology	3
	3.	Environmental Sciences	1
	4.	Marine mammals	2
	5.	Psychology/behavioral sciences	4
	6.	Research management	2

V Constraints upon acquisition/retention of specialty-trained veterinarians:

A. DOD/Congressionally mandated reduction of military veterinary service.

B. Civilianization of 102 military R&D positions by end of FY 83.

C. Governmental non-parity with civilian salaries.

D. Imposition of manpower and hiring ceilings.

E. Reduced growth of R&D budget in DoD life sciences fields.

F. Engineering/logistical constraints keep DoD research facilities behind growth and sophistication enjoyed in private sector.

G. DoD procurement system not designed to support viable biomedical research effort in timely fashion.

DOD-PRESENT VETERINARY STAFFING LEVEL

Table 1 - Specialty

Laboratory Animal Medicine	54
Veterinary Pathology	59
Toxicology	13
Radiobiology	3
Physiology	21
Surgery	13
Ecology/Environmental Science	3
Microbiology	21
Psychology	1
Public Health	71
Food Technology	20
	279

Table 2 - Educational Level

	MS	PhD
Laboratory Animal Medicine	54	0
Veterinary Pathology	49	10
Toxicology	10	3
Radiobiology	2	1
Physiology	15	6
Surgery	13	0
Ecology/Environmental Science	2	1
Microbiology	7	14
Psychology	1	0
Public Health	70	1
Food Technology	19	1
	242	37

Table 3 - Rank/GS Level

	03/GS-11	04/GS12	05/GS-14	06/GS-15
Laboratory Animal Medicine	10	19	18	7
Veterinary Pathology	20	21	13	5
Toxicology	3	4	3	3
Radiobiology	-	1	1	1
Physiology	7	7	4	3
Surgery	7	4	1	1
Ecology/Environmental Science	-	1	1	1
Microbiology	3	9	7	2
Psychology	-	1	-	-
Public Health	2	14	31	24
Food Technology	2	10	7	1
	54	91	86	48

Total 279

DOD - IN-CEILING VETERINARY STAFFING NEEDS - 1985

Table 4 - Specialty

Laboratory Animal Medicine	55
Veterinary Pathology	60
Toxicology	14
Radiobiology	3
Physiology	22
Surgery	13
Ecology/Environmental Science	3
Microbiology	21
Psychology	1
Public Health	71
Food Technology	18
	281

Table 5 - Educational Requirements

	MS	PhD
Laboratory Animal Medicine	55	0
Veterinary Pathology	39	21
Toxicology	8	6
Radiobiology	2	1
Physiology	15	7
Surgery	13	0
Ecology/Environmental Science	0	3
Microbiology	6	15
Psychology	1	0
Public Health	70	1
Food Technology	17	1
	226	55

Table 6 - Rank/GS Level

	03/GS-11	04/GS-12	05/GS-14	06/GS-15
Laboratory Animal Medicine	10	19	18	8
Veterinary Pathology	20	21	13	6
Toxicology	3	4	4	3
Radiobiology	-	1	1	1
Physiology	6	8	5	3
Surgery	6	5	1	1
Ecology/Environmental Science	-	1	1	1
Microbiology	3	9	7	2
Psychology	-	1	-	-
Public Health	2	15	31	23
Food Technology	2	9	6	1
	52	93	87	49

Total 281

DOD - IN-CEILING VETERINARY STAFFING NEEDS - 1990

Table 7 - Specialty

Laboratory Animal Medicine	56
Veterinary Pathology	61
Toxicology	15
Radiobiology	3
Physiology	23
Surgery	13
Ecology/Environmental Science	3
Microbiology	21
Psychology	1
Public Health	71
Food Technology	15
	282

Table 8 - Educational Requirements

	MS	PhD
Laboratory Animal Medicine	56	0
Veterinary Pathology	39	22
Toxicology	8	7
Radiobiology	2	1
Physiology	15	8
Surgery	13	0
Ecology/Environmental Science	0	3
Microbiology	6	15
Psychology	1	0
Public Health	70	1
Food Technology	14	1
	224	58

Table 9 - Rank/GS Level

	03/GS-11	04/GS-12	05/GS-14	06/GS-15
Laboratory Animal Medicine	10	19	18	9
Veterinary Pathology	20	21	13	7
Toxicology	3	4	4	4
Radiobiology	-	-	2	1
Physiology	5	8	6	4
Surgery	6	4	2	1
Ecology/Environmental Science	-	1	1	1
Microbiology	2	8	9	2
Psychology	-	-	1	-
Public Health	8	13	30	20
Food Technology	2	5	7	1
	56	83	93	50

Total 282

DOD - DESIRED VETERINARY STAFFING LEVELS - 1985

Table 10 - Specialty

Laboratory Animal Medicine	64
Veterinary Pathology	70
Toxicology	16
Radiobiology	4
Physiology	25
Surgery	15
Ecology/Environmental Science	4
Microbiology	24
Psychology	1
Public Health	71
Food Technology	18
	312

Table 11 - Educational Requirements

	MS	PhD
Laboratory Animal Medicine	64	0
Veterinary Pathology	49	21
Toxicology	10	6
Radiobiology	3	1
Physiology	18	7
Surgery	15	0
Ecology/Environmental Science	1	3
Microbiology	9	15
Psychology	1	0
Public Health	70	1
Food Technology	17	1
	257	55

Table 12 - Rank/GS Level

	03/GS-11	04/GS-12	05/GS-14	06/GS-15
Laboratory Animal Medicine	14	22	20	8
Veterinary Pathology	25	24	15	6
Toxicology	3	5	4	4
Radiobiology	1	1	1	1
Physiology	8	8	5	4
Surgery	7	4	2	2
Ecology/Environmental Science	-	1	2	1
Microbiology	3	10	8	3
Psychology	-	-	1	-
Public Health	2	15	31	23
Food Technology	2	9	6	1
	65	99	95	53

Total 312

DOD - DESIRED VETERINARY STAFFING NEEDS - 1990

Table 13 - Specialty

Laboratory Animal Medicine	69
Veterinary Pathology	75
Toxicology	23
Radiobiology	4
Physiology	33
Surgery	17
Ecology/Environmental Science	6
Microbiology	24
Psychology	3
Public Health	71
Food Technology	15
	340

Table 14 - Educational Requirements

	MS	PhD
Laboratory Animal Medicine	69	0
Veterinary Pathology	50	25
Toxicology	13	10
Radiobiology	3	1
Physiology	20	13
Surgery	14	3
Ecology/Environmental Science	2	4
Microbiology	5	19
Psychology	2	1
Public Health	70	1
Food Technology	14	1
	262	78

Table 15 - Rank/GS Level

	03/GS-11	04/GS-12	05/GS-14	06/GS-15
Laboratory Animal Medicine	11	25	21	12
Veterinary Pathology	18	27	21	9
Toxicology	8	5	5	5
Radiobiology	-	2	1	1
Physiology	9	10	8	6
Surgery	5	6	3	3
Ecology/Environmental Science	1	2	1	2
Microbiology	1	8	10	5
Psychology	-	1	1	1
Public Health	8	13	30	20
Food Technology	2	6	6	1
	63	105	107	65

Total 340

DEPARTMENT OF THE INTERIOR

Response from National Wildlife Health Laboratory

I. Legislation and regulations that impact upon the FWS with respect to requirements for specialty-trained veterinary manpower.

The Animal Welfare Act is the only legislation we perceive as having any impact upon our need for veterinary services. However, these services may be provided under contract rather than employment of in-house staff.

II. Staffing levels of veterinary manpower

A. Present staffing levels

Name	Educational Level	GS Level	Specialty
Dr. L. Locke	DVM, B.S.	GS 13	Pathology, Wildlife Disease Specialist
Dr. L. Siegfried	DVM, Ph.D.	GS 13	Pathology
Dr. R. Stroud	DVM, M.S.	GS 13	Pathology
Dr. R. Lange	DVM, M.S.	GS 12	Pathology, Wildlife Disease Specialist
Dr. S. Schmeling	DVM, M.S.	GS 9	Animal health
Dr. J. Carpenter	DVM, M.S.	GS 13	Animal health
Dr. C. Franzen	DVM, B.S.	GS 12	Pathology

B. Projected ceiling needs for 1985 and 1990

No change from above

C. Desired staffing levels for 1985 and 1990

No change from above. For the most part a veterinary degree is not required for the types of positions utilized by the FWS. Our experience has shown that veterinarians that do not also have specialized training in wildlife ecology do not have the perspective necessary to meet the needs of our programs. The only area where a veterinary degree is required is in the area of animal health. This is a very limited area of involvement within the FWS. Field diagnostician positions can also best be filled by veterinarians provided they are also well grounded in wildlife ecology. Here again the number of positions is very limited and given the choice of a DVM with no training in wildlife, or a Ph.D. that has specialized in wildlife disease we would take the Ph.D.

D. Justifications of the above data.

None available

III. Estimate impact of federal agency activity on non-federal manpower requirements by specialty.

FWS activities involving veterinarians are insignificant in terms of manpower utilization. Therefore, it is unlikely that we impact on Industry, State, or Educational Institutions at the present time, nor that we will in 1985, or 1990.

IV. Specify job descriptions and types of training beyond the DVM which might satisfy newly expanding roles for veterinarians in the biomedical sciences.

We see no expanded roles for veterinarians within the FWS beyond current utilization. Wildlife trained veterinarians are far more valuable to us than non-wildlife trained individuals. However, job opportunities are quite limited (1 or 2 individuals each 2 years due to turnover), therefore, we do not see this as an area of need that would justify an expanded training program. One school of veterinary medicine with a good program in wildlife diseases could satisfy all our needs many times over.

V. Describe constraints on the acquisition and retention of specialty-trained veterinary manpower in the FWS.

There are no constraints on the acquisition of veterinarians that go beyond OPM regulations that apply to all potential employees. Salary limitations do not make us competitive with industry for specialties such as pathology and microbiology and since research positions generally require a Ph.D., a DVM-Ph.D. is also often beyond our salary range.

Response from Patuxent Wildlife Research Center to Memorandum, "Veterinary Manpower" (12/11/80, Smith)

I. See submission from National Wildlife Health Laboratory

II. A (1) One Research Histopathologist
Two Research Veterinarians

(2) One is PhD
Two are MS plus DVM

(3) One GS-12
Two GS-13

B no change

C. no change

D. N/A

III. N/A

IV. A. Histopathology (DVM not required) - one PhD
Veterinary Services - part time of two } MS
Endangered Species - part time of one } plus
Environmental Pollutants - part time of one } DVM

B. none

V. None

ENVIRONMENTAL PROTECTION AGENCY

Survey on Veterinary Specialists Employed by the Environmental Protection Agency

I. Legislation and Regulations that Impact EPA on Requirements for Specialty - trained Veterinary Manpower

A. Existing Legislation and Regulations

Toxic Substances Control Act
Federal Insecticide, Fungicide, and Rodenticide Act
Clean Air Act
Safe Drinking Water Act
Resource Conservation and Recovery Act
Federal Water Pollution Control Act

B. Legislation and Regulations anticipated to be passed and/or implemented during FY 81

None anticipated

II. Staffing Levels of Specialty - trained Veterinary Manpower

A. Present Staffing Levels - 22 total

1. Toxicology (including radiobiology) - 13

   a. Grade *
      CC06 - 6
      GS16 - 1
      GS15 - 4
      GS14 - 1
      GS9 - 1

   b. Degrees post - DVM (highest)
      PhD or equivalent - 5
      MS/MPH - 5
      None - 3

2. Pathology - 5

   a. Grade
      SES - 1
      CC06 - 2
      GS15 - 2

   b. Degrees post - DVM (highest)
      PhD - 2
      MS - 3

3. Epidemiology - 3

   a. Grade
      CC06 - 1
      CC04 - 2

b. Degrees post - DVM (highest)
MPH - 3

4. Laboratory Animal Medicine - 1

a. Grade - CC06

b. Degrees post - DVM - None

*CC = Commissioned Corps of Public Health Service. For comparability to Civil Service GS ratings, CC06 is equivalent to GS15/16/17/SES; CC05 to GS14/15; CC04 to GS13/14.

B. Projections for 1985 and 1990. No projections available. However, best estimates for 1985 would indicate about same level of staffing with some growth (10-20%) possible by 1990.

C. Desired staffing levels for 1985 and 1990.
No program documents indicate such breakdown for veterinary - specialists.

D. No manpower studies are available reflecting changes in EPA programs now underway.

III. Impact of federal agency activity on non-federal manpower requirements by specialty

No analysis has been prepared regarding the impact of EPA regulations on non-federal manpower requirements. A study regarding impact of TSCA is planned for 1981-82. With the implementation of TSCA programs on testing under Section 4 and notification under Section 5, it is anticipated that an increased need for scientists will occur in testing and hazard assessment roles.

IV. Job descriptions and type training beyond the Doctor of Veterinary Medicine degree which might satisfy newly expanding roles for veterinarians in the biomedical sciences

A. Roles and Veterinarians filling positions: Program Management - several veterinarians are currently program managers; veterinarians having specialized training could qualify for other management positions now filled by other health disciplines.

Risk Assessment - this is a multi-discipline activity in which many veterinarians currently play a role. Veterinarians could have more importance in this area with specialized training in comparative toxicology, pathology and statistics. Most EPA veterinarians are involved in certain aspects of risk assessment now.

Toxicology - approximately 40 toxicologists are employed at the EPA including 13 veterinarians with toxicology training. Nearly all are at GS14 level or higher. Nearly all non-veterinarian toxicology positions could be filled by veterinary toxicologists.

Other Medicine/Health Science Disciplines - Currently EPA employs approximately 900 scientists in various disciplines, perhaps half of which are in health areas, e.g. pharmacology, microbiology, pathology, physiology, genetics, environmental health, etc. Many of these (perhaps 10-20%) could be manned by veterinarians with specialized training.

V. Constraints on acquisition and retention of specialty - trained veterinary manpower at EPA

There are no unusual constraints specific to veterinarians as such. Recruitment and retention problems at EPA have generally resulted from the philosophical differences sometimes seen between scientists and administrators peculiar to most regulatory agencies. Administrative/legal qualifications often have gained greater recognition from program officials than scientific abilities and viewpoints. A regulatory scientist must be able to integrate science with non-science policy such as economic or enforcement constraints. Many scientists have difficulty in adjusting to this, feel uncomfortable in the regulatory environment, and often return to the research community. Perhaps training in regulatory science and public decision-making would be helpful in creating a manpower pool for such public service.

DATA REQUESTED REGARDING THE IMPLICATIONS OF LEGISLATION AND REGULATIONS ON THE NEED FOR VETERINARY MANPOWER

I. Please specify the legislation and regulations that impact your agency with respect to requirements for specialty-trained veterinary manpower:

A. Existing legislation and regulations.

Primary sections of the Food, Drug and Cosmetic Act requiring specialty-trained veterinarians to enforce it are: 402(a), 403(a), 409, 501(a)(5), 501(a)(6), 502(a),502(F)(1), 507 and 512.

Primary parts of the regulations (Title 21, Code of Federal Regulations) are: 201.105, 202, 500, 510.300, 510.310, 511 and 514.

In addition, the recently implemented Good Laboratory Practice Regulations and the Animal Welfare Act require specialty-trained veterinary manpower for compliance and enforcement.

B. Anticipated legislation and regulations.

Regulations are being proposed that would amend CFR 21, Part 54 to implement the regulation of clinical investigations. Specialty-trained veterinarians will be required to administer this regulation.

II. Please provide the following information with respect to the staffing levels of specialty-trained veterinary manpower:

A, B, C. Present, Projected, Desired staffing levels.

The present, projected and desired staffing levels are shown in the attached Table 1.

D. Indicate by reference any justifications of the above data, such as internal studies of manpower needs, that may be pertinent.

No manpower studies are available, however, the data in Table 1 reflect the increasing involvement of the Federal government in chemical testing, e.g., in the National Toxicology Program and the general requirement for veterinary specialization, as research, data collection and the data review procedures become more precise and sophisticated.

III. Please estimate the impact of federal agency activity on non-federal manpower requirements by specialty:

A, B, C. Impact of federal activity on industry, state and educational institutions.

We do not have data to estimate the impact of federal agency activity on non-federal specialty manpower requirements, however, we do believe that the need for specialty training will continue to evolve as a result of at least three factors:

1. Legislative/societal pressure for protection of public health and environmental health in an increasingly complex yet rapidly shrinking (in terms of size vs burden) global environment.
2. New technology, e.g., genetic engineering, advances in immunopharmacology, antiviral technology.
3. Normal growth/expansion of current services associated with factors such as population growth, extension of services to currently under-developed countries, etc.

It should be noted that these factors are not exclusive of one another, but rather are closely interrelated. Further, it should be noted that manpower requirements do not necessarily result from an action in the federal sector, i.e., many federal sector requirements result from developments in the private sector.

IV. Specify job descriptions and type of training beyond the Doctor of Veterinary Medicine degree which might satisfy newly expanding roles for veterinarians in the biomedical sciences.

A. List such roles in your agency, including numbers of veterinarians filling these positions.

The veterinarian, by virtue of training and experience, is uniquely qualified for very broad roles in public health and environmental health areas. Aquaculture is another emerging area where veterinary expertise is required. The Agency does not now have veterinarians full-time in these positions. The Agency does have a veterinarian employed in the area of government to consumer communications, i.e., thru publications, public speaking, etc., consumers are informed of governmental activities.

B. List such roles not now being filled by veterinarians due to manpower shortages. Include training of such individuals, if known.

New roles as mentioned in IVA above are being filled by veterinarians, however, with more veterinarians specialty-trained in such areas as public health, epidemiology, aquatic animal diseases and public communications, veterinarians will expand into these areas at a more rapid rate as a result of their unique qualifications and skills.

V. Please describe constraints, if any, on the acquisition and retention of specialty-trained veterinary manpower in your federal agency.

Please indicate key references for the data that you have provided, if available, or other basis upon which you have developed your replies.

The single largest constraint is the lack of imagination and foresight on the part of the veterinary profession to develop programs which are responsive to the expanding needs of society. In addition, the inability of the Agency to offer a competitive salary, clear career advancement and the always present budgetary constraints add to the difficulty of acquiring and retaining specialty-trained veterinarians.

Key references (reports) for the information in this questionnaire do not exist. Of course, background laws and regulations such as the Food, Drug and Cosmetic Act and the Good Laboratory Practice Regulations are available, but comprehensive manpower studies are not available. These data represent a compilation of the best estimates from those directly involved in various Agency programs.

TABLE 1

SPECIALTY	EDUCATIONAL LEVEL[1]	GRADE	PRESENT	PROJECTED 1985-1990	DESIRED 1985-1990
Epidemiology	MPH or Ph.D.	GS-13	3	3	5
Equine Specialist	-	GS-14	1	1	1
Immunology	Ph.D.	GS-14	-	-	2
Laboratory Animal Medicine	MS, Ph.D. &/or Board Certified	0-5, 0-6, GS-14	4	5	9
Large Animal Clinician	MS	GS-13	-	1	1
Microbiology	Ph.D.	GS-13 to 0-6	4	6	7
Molecular Biology	MS	GS-14	1	1	1
Nutrition	MS	GS-13	1	1	2
Parasitology	MS	GS-13	1	2	3
Pathology	MS, Ph.D. &/or Board Certified	0-4, GS-14, GS-15	5	13	27
Pharmacology	MS, Ph.D.	GS-13 to GS-14	4	9	13
Physiology	MS, Ph.D.	GS-13, 14	3	8	10
Poultry Specialist	-	GS-14	1	1	1
Theriogenologist	MS, Bd.Cert.	GS-13, 14	1	1	1
Toxicology	MS, Ph.D. &/or Board Certified	GS-13 to GS-15	5	8	12

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[1] In addition to the DVM. These are current levels. Projected levels could be at the MS, Ph.D. &/or Board Certification level. The primary criteria are that individuals must be qualified and recognized as experts in their respective disciplines.

APPENDIX H

BIOGRAPHIC SKETCHES OF COMMITTEE MEMBERS

Biographic Sketches of Committee Members

Donald A. ABT is the Associate Dean of the School of Veterinary Medicine at the University of Pennsylvania in Philadelphia. He is also the Director of Aquavet, the Program in Aquatic Veterinary Medicine conducted each summer at the Marine Biological Laboratory in Woods Hole, Massachusetts. He received a B.S. degree in 1957 at the University of Massachusetts and a V.M.D. in 1961 at the University of Pennsylvania. Dr. Abt is Professor of Epidemiology and Biostatistics in the Graduate Faculty of the College of Arts and Sciences, as well as in the School of Veterinary Medicine of the University of Pennsylvania. He is a member of the Research Advisory Board of the Institute for Environmental Medicine of the University of Pennsylvania. He has published numerous articles in oncology, epidemiology, and hematology.

Colin M. BLOOR is Professor of Pathology at the University of California School of Medicine, San Diego. He received a B.S. at Dennison University in 1955 and an M.D. at Yale University School of Medicine in 1960. He is a Fellow of the American College of Cardiology; a Fellow of the Council of Circulation, American Heart Association; a Councilor of the International Academy of Pathology; and a member of the American Association of Pathologists and the American Physiological Society. He also serves on numerous local, state, and national committees and on editorial boards of pathology and cardiovascular medical journals. Dr. Bloor has written five books, including one on cardiac pathology, as well as numerous other publications.

Walter C. BOWIE is a Professor of Physiology and Dean of the School of Veterinary Medicine at Tuskegee Institute. He received a D.V.M. at Kansas State College in 1947 and an M.S. and Ph.D. in physiology at Cornell University in 1960. His special interests are in cardiovascular and ruminant physiology. He has served on many committees, including those of federal agencies, national and international veterinary societies, primate centers, and the American Heart Association. Dr. Bowie has been a Visiting Professor at Howard University and at the University of Alabama Medical Center, as well as an Adjunct Professor at Cornell University.

W. Jean DODDS is the Research Director of the Laboratories for Veterinary Science, New York State Department of Health at Albany. She received a D.V.M. degree in 1964 at the Ontario Veterinary College, University of Toronto, Guelph, Canada. She also has adjunct professorial appointments in medicine and physiology at the Albany Medical College, in medicine at the University of Pennsylvania School of Veterinary Medicine, and in pathology at the Albany Veterans' Administration Medical Center and the New York State College of Veterinary Medicine. She is a visiting Lecturer in Medicine at the Tufts University School of Veterinary Medicine. Dr. Dodds's research interests include comparative thrombosis and hemostasis, comparative immunohematology, laboratory animal medicine, and animal models. She has published numerous papers and textbook contributions in these fields. In addition, Dr. Dodds has served on various advisory and study committees for the NIH, the American Heart Association, the National Research Council, and other national and international groups.

James G. FOX is an Associate Professor and Head of the Division of Comparative Medicine at the Massachusetts Institute of Technology in Cambridge. His undergraduate training was at the University of Oregon and the University of Nevada in 1961-1964; he received a D.V.M. at Colorado State University in 1968 and an M.S. in medical microbiology and laboratory animal medicine at Stanford University in 1972. He became a Diplomate in the College of Laboratory Animal Medicine in 1974. Dr. Fox has served with the U.S. Army Veterinary Corps, in private practice, and as a consulting veterinarian with several animal hospitals, research institutes, and federal agencies. He has written many research articles and publications on veterinary manpower.

John R. GORHAM is a Research Leader at the Animal Disease Research Unit with the U.S. Department of Agriculture at Pullman, Washington. He received a B.S. and D.V.M. at Washington State University in 1946, an M.S. in pathology at Washington State University in 1948, and a Ph.D. in virology at the University of Wisconsin in 1953. He is a Professor of Veterinary Microbiology and Pathology at the College of Veterinary Medicine at Washington State University. Dr. Gorham's research specialties include slow-virus diseases, acute viral and rickettsial diseases, fur-bearing animal diseases, and bacterial diseases of sheep and goats. He has served as a consultant and lecturer on a variety of foreign assignments, and he led the U.S.-USSR Cultural Exchange Mission in Veterinary Medicine to the USSR in 1975.

Albert M. JONAS is the Chairman of the Department of Comparative Medicine and Professor of Experimental Pathology at the Tufts University School of Veterinary Medicine. He received a D.V.M. at the University of Toronto, Ontario Veterinary College, Guelph, Canada, in 1955, and he became a Diplomate in the American College of Veterinary Pathologists in 1963. He was awarded an M.A. (Honorary) from Yale University in 1974. He has served on a variety of committees and panels for federal agencies, primate centers, and the National Research Council. Dr. Jonas served as a member of the Examining Board of the American College of Veterinary Pathologists, and he is a consultant to a wide variety of industries, institutes, and universities. His research specialties include comparative pulmonary pathology and the pathology of laboratory animals.

Richard J. KOCIBA is a Senior Associate Scientist with Dow Chemical USA Toxicology Research Laboratory. He received a D.V.M. in 1966 and a Ph.D. in pathology in 1970 at Michigan State University. He is a Diplomate in the American College of Veterinary Pathologists and the American Board of Toxicology. Dr. Kociba serves on panels and committees for foundations, institutes, and federal agencies. He is on the editorial board of Veterinary Pathology Journal, and he publishes widely in pathology and toxicology.

Raymond W. LOAN is Associate Dean for Research and Graduate Studies at the College of Veterinary Medicine, Texas A&M University. He received a B.S. in 1952 and a D.V.M. in 1958 at Washington State University and an M.S. in 1960 and a Ph.D. in animal pathology in 1961 at Purdue University. Dr. Loan has served on many academic teaching and research committees. His publications are in microbiology, immunology, and pathology. He recently served at the U.S. Department of Agriculture as the staff leader for a special study in veterinary education.

Richard B. TALBOT is the Dean of the Virginia-Maryland Regional College of Veterinary Medicine at Virginia Polytechnic Institute and State University. He received a B.S. in 1954 and a D.V.M. in 1958 at Kansas State University and a Ph.D. in physiology in 1963 at Iowa State University. He has served as a faculty member, Department Chairman, and Dean at the College of Veterinary Medicine of the University of Georgia. Dr. Talbot has consulted in academic administration and health manpower for the federal government, Tufts University, and the American Association of Veterinary Medical Colleges. He is the editor of Journal of Veterinary Medical Education.